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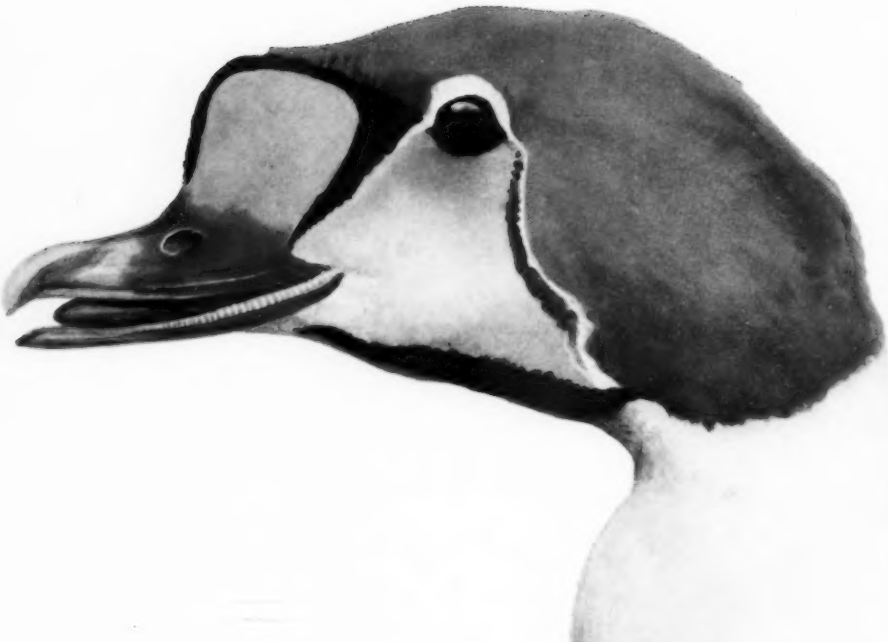

Fig. 1. Head of male King Eider sketched in the field by G. M. Sutton from a fresh specimen shot on Southampton Island, 30 June 1930. Note the dark eyes.

ON CERTAIN ANATIDS OF FROBISHER BAY, BAFFIN ISLAND

George Miksch Sutton* **and David F. Parmelee†**

IN SUMMER 1953 the writers carried out field work near the head of Frobisher Bay from June 14 to August 22. An eighteen-square-mile area, most of it high "desert tundra" east and northeast of the Royal Canadian Air Force station, was covered fairly regularly by foot. Several islands at the head of the bay were visited, and two boat trips were made to the mouth of the Jordan River, sixteen miles west of the station. On the first of these trips we were guests of the Hudson's Bay Company, and on the second of the Royal Canadian Mounted Police. In addition the Royal Canadian Air Force kindly flew us to several areas well away from Frobisher Bay, including the southeast shore of Lake Amadjuak, and Cape Dorchester at the northwest tip of Foxe Peninsula.

According to Soper (1928, pp. 87–95; 1946, pp. 16–24), the following anatids breed in southern Baffin Island: Whistling Swan (*Cygnus columbianus*), Canada Goose (*Branta canadensis*), Brant (*B. bernicla*), Snow Goose (*Chen hyperborea*), Blue Goose (*C. caerulescens*), Old-squaw (*Clangula hyemalis*), Harlequin Duck (*Histrionicus histrionicus*), Common Eider (*Somateria mollissima*), King Eider (*S. spectabilis*), and Red-breasted Merganser (*Mergus serrator*). Of these 10 forms we recorded 7, all of them at the head of Frobisher Bay.

Canada Goose (*Branta canadensis*)

The Canada Goose nested in considerable numbers at the head of the bay. We first recorded one on June 16 in high land east of the airfield. It was a large bird, not the little Barren Grounds Goose (*B. c. hutchinsi*), a subspecies seen by Sutton on Southampton Island (Sutton, 1932a, pp. 36–41). On June 18 we saw a flock of geese—4 Canadas and 1 Snow Goose (*Chen hyperborea*) flying high in the air northward along the Sylvia Grinnell River. By this date the goose migration must have been largely over, although 10 Canada Geese were seen flying westward in a flock along the shore as late as June 27.

From June 16 to July 10 a pair of geese was seen frequently on the low land between the airfield and the mouth of the Sylvia Grinnell River, and on June 21 Sutton came up on 2 Canada Geese two miles northeast of the airfield. They were feeding in a grassy spot below a big snowbank, and

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showed no alarm, standing their ground until Sutton was within shotgun range. Neither bird had a light zone encircling the forepart of the body just below the black of the neck. No geese were seen in the area again, but on July 3 a pair of geese was observed near the mouth of the Sylvia Grinnell River.

We were unable to find any nests. V. C. Wynne-Edwards saw a family of Canada Geese, consisting of a pair and 4 young, close to the place where we had first recorded the species; the parents almost certainly had a nest somewhere between the airfield and the Hudson's Bay Company post. On July 18

Fig. 2. Flightless adult and young Canada Geese scrambling up river bank near Tarr Inlet, 4 August 1953.

we found a pair of geese and 5 half-grown goslings swimming in a line in the Jordan River, not far from the mouth. We had expected to find geese in this area because of the numerous goose tracks, feathers, and droppings on the firm grassy tidal flats nearby, and we located the geese by the noise they were making. Before long the parents climbed out of the water, leaving the goslings bunched together; they made no attempt to follow.

Our earliest date for a moulted wing quill was July 24, when we found a primary far east of the station. Many geese remained in flying condition throughout July, and 2 were seen flying over the mouth of the Sylvia Grinnell River, honking loudly, on August 1. Two days later, Parmelee came upon a company of about 30 Canada Geese in a long, narrow pond in marshy tundra, about a mile east of Tarr Inlet. He judged them all to be flightless; more than half of them appeared to be well-grown young. Next day we found

them, or a similar company, on a pond about a mile farther northeast. Among the young birds there were a few small ones, still largely downy, but the company moved at great speed when startled. We followed the geese to a winding river, where Parmelee went downstream, and Sutton went to a narrow defile near the river from where he saw about 150 Canada Geese, mainly adults or well-grown young, swimming rapidly with the current. Parmelee, meanwhile, shot a stub-winged adult. This alarmed the flock, and some geese raced up the opposite bank (Fig. 2). Sutton followed, heading for a hill to the east, from which he saw a great meander flanked on one side by a steep

Fig. 3. Adult and young Blue Geese swimming in meander near Tarr Inlet. Four or five birds may be young Lesser Snow Geese, 4 August 1953.

bank about eighty feet high. In the water there was a mass of geese, mostly Canadas, some Blue Geese (*Chen caerulescens*), and some which could not be identified (Fig. 3).

Sutton worked downstream, and Parmelee upstream, and the geese, cornered at last, tried in vain to climb the steep bank. Several Canada Geese and 2 Blue Geese took to the air and, honking loudly, flew to the tidal flats half a mile away. The flightless birds, about 125 Canada Geese and 70 Blue Geese, and a few light-coloured geese which we called "young Lesser Snow Geese", stayed in the river, moving *en masse* this way and that. When the geese were not followed so closely they became surprisingly docile, and the Canadas formed a separate flock. The "young Lesser Snows" stayed with the Blue Geese. As we were leaving the river the flightless birds made another dash up the bank and managing to make the top, raced off coastwards.

Parmelee caught the last bird to reach the top, a very young Canada gosling, which we banded, photographed, and released. Its plumage was wholly downy (Fig. 4).

The specimen we had shot was a very fat female. Earlier in the season it must have had a large brood-patch, for there were fresh, fully-developed grey feathers in the middle of the belly, quite different in appearance from the worn, brownish, unmoulted feathers surrounding them. This bird does not seem to us representative of the nominate race, despite the inclusion of southeastern Baffin Island in the form's breeding range by Delacour (1951, p. 5) and Soper (1946, pp. 16–7). It does not have the "conspicuous light-colored area on the upper back" believed by Todd (1938, p. 662) to be an important character of *canadensis*. The dark greyish brown of the back extends forward to the back of the neck, without becoming lighter. The bill-length, 49 mm., is slightly below that of the smallest of 7 *canadensis* (51.5 mm.) measured by Aldrich and is close to his average (49.7 mm.) for 10 female *B. c. interior* (Aldrich, 1946, p. 98). The tail-length, 136 mm.–possibly not a valid measurement, for only ten full-length rectrices, all of outgoing plumage, are present–falls within Aldrich's extremes for either *canadensis* or *interior*. The wing-length is valueless, as all the remiges are stubby. The tarsus-length, 90 mm., is the same as that of the longest-legged *interior* measured by Aldrich and greater than that of his longest-legged *canadensis* (88.5 mm.). To the best of our knowledge neither Delacour nor Aldrich examined Baffin Island specimens, and we think that Soper, who gives no measurements for the 9 *canadensis* he discusses (1946, p. 17), did not consider that these birds might be *interior*. Further information must be obtained, but it seems likely that the breeding form of southeastern Baffin Island is *B. c. interior*.

Snow Goose (*Chen hyperborea*)

The Snow Goose which we saw on June 16 was smaller than its 4 Canada Goose companions.

The light-coloured geese referred to above as "young Lesser Snows" were different from the many young Blues of the flock. They were somewhat downy all over the head and neck, but the plumage beneath the down was very pale; their backs were light grey, and their under parts almost white. These birds do not appear in our photograph (Fig. 3) which shows only part of the flock. We failed to see any really white birds. White geese seen by personnel of the Royal Canadian Air Force near Cape Dorchester in mid-summer must have been some form of Snow Goose.

Blue Goose (*Chen caerulescens*)

Only 2 of the 70 Blue Geese we observed seemed to be quite unable to fly. The young birds were mostly smaller than the adults and were somewhat downy, especially on the head and neck. Among the adults we noticed none of the "piebald" colouration discussed by Sutton (1931, p. 359) and figured by Bent (1925, plate 1). We do not know where these Blue Geese nested; the Eskimo did not know of a nesting place in the vicinity. The Blue Goose's

Fig. 4. Downy young Canada Goose captured near Tarr Inlet, 4 August 1953.

principal breeding ground on Baffin Island is the shores of Bowman Bay, far northwest of Frobisher Bay (Manning, 1942, p. 169). Soper (1946, p. 20) states that the Blue Goose "occurs irregularly north to Cumberland Sound", but he mentions no midsummer records for southeastern Baffin Island.

Old-squaw (*Clangula hyemalis*)

Wynne-Edwards (1952, p. 362) did not see this species in the Frobisher Bay area in 1937 or 1950. In 1953 we saw it almost daily, usually in lakes well back from the sea, from June 17 to August 10. We were told that in early June a mixed flock of males and females was seen repeatedly at high tide along the shore east of the Hudson's Bay Company post; this flock had broken up by the time we arrived. We witnessed no courtship behaviour, and only infrequently did we hear the *ah, ah away* call note.

We saw birds in moulting condition throughout our stay. Those seen between June 17 and June 21 were all marked with white on the crown, occiput, and back. On June 22 we carefully inspected a male and female in a pond near the airfield. The male was in full summer dress, but the head and neck of the female were very irregularly blotched with white. Single males seen during the next three days appeared to be in complete summer feather.

On June 30 near the Sylvia Grinnell River we collected a male (GMS 11736) whose plumage was an interesting mixture. A large, irregular patch

of white on the nape, a sprinkling of white on the hind neck, three or four white feathers on the upper chest, and one white feather on the back, indicated that the moult into summer plumage was not finished. The moult of the lower chest had not even started, and the feathers of the courting (winter) plumage (Sutton, 1932b) were dull and brown compared with the new, glossy, blackish feathers of the neck and upper chest. The bird could be described as black-necked and brown-chested, the lower limits of the black neck and upper chest being precisely those of the white neck and upper chest of the courting dress. Phillips (1925, p. 350) was aware of this very condition, for he states that the summer dress is acquired by a moult of the "head, neck, mantle, scapulars, *upper* breast and flanks" (italics ours). The brown feathers of the lower breast are, of course, replaced during some stage of the post-nuptial moult, but the replacement is not easy to detect. The middle tail feathers of the specimen are 150 mm. long. The bird was fairly fat; the testes, which were slightly pyriform, each measured 28 x 9 mm.

A female in full summer dress was seen on July 9 on "HBC River". On July 18, 3 males seen in the thawed part of a lake not far from Silliman's Fossil Mount were in "full" summer feather; they could all fly well.

We found no nests and from mid-June to mid-July few of our observations led us to believe that we were close to a nest. Several ducks with young were, however, seen by the writers and other observers. On July 26 we surprised a female with 2 young, about a third grown, on an island in a lake two miles north of the airfield. On July 31 some Eskimo children found a small duckling alive in water near the Hudson's Bay Company post, and we preserved it as a specimen (GMS 11798, male). Phillips (1925, p. 362) says that "in most of the far-northern nesting areas late June and the first half of July constitute the regular laying period, and newly hatched broods are found well into August".

Common Eider (*Somateria mollissima*) and King Eider (*S. spectabilis*)

We only saw eiders at sea. On June 20 we saw 3 Common Eiders, 2 males and a female, well out from Davidson Point, near the mouth of the Sylvia Grinnell River. This was our only positive record for this area. However, the waters off the mouth of the Jordan River—a bay sometimes referred to as "Jordan Bay"—were a favourite feeding ground of both the Common Eider and the King Eider, and it was here that we saw most eiders. It is an area with strong ocean currents, and at low tide mud-flats stretched out miles from the shore. The eiders fed on clams and snails that lived in the mud.

We first visited this area on July 13 by motorboat. As we moved landwards the big ducks became more numerous. We soon gave up trying to keep a record as clouds of ducks were rising in the distance. Whether aware of our approach or not, the eiders had reason for flying, for the incoming tide was rapidly covering their feeding grounds. Lines of ducks crossed and re-crossed the path of the boat, moving steadily and swiftly, sometimes coming quite close. Many of the flocks were composed wholly of brown subadult or off-colour males.

We stopped at a narrow, rocky, ice-covered island. The first bird we shot was a King Eider, a species we had not, up to then, identified with certainty. On another island we found several Common Eider nests, all above the high-tide mark in mossy, well-sheltered places. Many of the nests were fresh-looking, but without eggs. We collected a clutch of four fresh eggs, fouled by a departing hen.

Near this island we shot a crippled female *mollissima* (GMS 11753), unable to fly because of an old wing-wound. It was quite fat (4 lb., 3 oz.); its stomach contained a few pieces of gravel. We found no sign of a brood-patch among the belly plumage.

The two other specimens collected that day were male King Eiders. Both of them were dark-eyed, in this respect being similar to all the specimens collected by Sutton on Southampton Island (1932a, p. 78) (Fig. 1). One (GMS 11751) was a fat (3 lb., 13 oz.) adult in post-breeding condition. The bill was shrunken at the base, and dull-coloured; the plumage pattern was that of a courting bird, but the colours lacked brilliance and the skin was set with stubby pinfeathers. The gizzard held gravel and pieces of mussel shell. The other (GMS 11752) probably never had worn bright plumage, and was, in general, brownish, with bill like that of a female, unswollen at the base. The chest, however, was sprinkled with whitish feathers and the sides and flanks were blackish. There was no white spot at either side of the rump. This bird was very fat (3 lb., 9 oz.). Its gizzard held a perfect specimen of truncated clam (*Mya truncata*) about 54 mm. long (shell proper, 37 mm.), and an equally perfect black clam (*Modiolus nigra*) about 33 mm. long, and a considerable amount of gravel.

On our second visit to "Jordan Bay", July 17 to 20, we again saw numerous eiders, especially near the mouth of the Jordan River. Most of them appeared to be male *mollissima* in high plumage. Moulted body feathers lay everywhere on the water. We collected an adult male, feeding in water about ten feet deep. The bird's wings seemed to be in full feather, and its body plumage was not moulting heavily. The tarsi and tops of the toes were rich orange-brown, the webs greyish-black; the bill light olive at the tip, deepening to dull orange at the base. The gullet contained small clams, with and without shell, and snails. The gullet and stomach contents, as identified by D. V. Ellis, were: 4 pelecypod molluscs (1 *Saxicava arctica*; 3 *Modiolaria discors*) and 2 gastropod molluscs (1 *Natica pallida*, shell partly digested, identification uncertain; 1 *Buccinum* sp., shell partly digested).

Eiders continued to fly about our boat, as we left "Jordan Bay" on July 20, until we were four or five miles off shore; thereafter we did not see any. They were obviously fond of the rocky islands. One turf-covered island which we visited had dozens of old nests, several nest-basins, and one new nest, without eggs. We collected 2 *mollissima*, an adult male (GMS 11774), mostly in eclipse plumage but able to fly, and a brown subadult male (GMS 11775). The latter weighed 4 lb., 8 oz.

On July 29 we saw some *mollissima* among the islands south of the airfield on the opposite shore of the bay. They included some solitary brown birds; a

flock of 30 males in mixed plumage, flying strongly; a lone adult male in full breeding feather, and able to fly; and an adult male in flightless condition. We shot this bird. Its head and neck were dark, except for a veiling of white over the front part of the cheeks; the chest was rich buff, unspotted; the belly, rump and tail coverts solid black; and the back, including the upper surfaces of the wings, creamy white except for four rows of dark spots. The flight feathers had dropped very recently, for the incoming quills were mere stubs among the coverts.

The average size of the four *mollissima* eggs collected was 76.0 x 48.0 mm. The average for seventy Baffin Island *mollissima* eggs reported by Phillips (1926, p. 96) was 75.7 x 49.9 mm.

Red-breasted Merganser (*Mergus serrator*)

Kumlien reported that this species nested on cliffs of the Cumberland Peninsula, Baffin Island (1879, p. 94) but we did not see any nests. We first saw a Red-breasted Merganser on June 16, a female swimming alone between the bay-ice and the tidal flats not far from the airfield. Between June 19 and June 27 we saw the species three times along the Sylvia Grinnell River. On each occasion alarmed by our approach the birds flew strongly. On July 13 we saw two adults in salt water in the Jordan River area, and on July 19 3 adult females were feeding together in swift water near the Jordan River mouth. They all flew strongly.

On August 4 we came upon a female and 3 small young on a river east of Tarr Inlet. We collected 2 of the young–males a few days old (GMS 11809–10). The agitated mother, with full powers of flight, swam vigorously near us calling with a hoarse *quarr, quarr.*

These studies were made possible by a grant from the Arctic Institute of North America, with funds provided by the U.S. government. We are grateful to Corporal Robert Van Norman and Constable Robert P. Pilot, Royal Canadian Mounted Police, to Ross Peyton and Brandon Halloran, Hudson's Bay Company, to Dr. V. C. Wynne-Edwards, Aberdeen University, and to personnel of the Royal Canadian Air Force for assistance in the field. We are especially grateful to D. V. Ellis, McGill University, for his identification of certain shellfish.

References

Aldrich, John W. 1946. "Speciation in the white-cheeked geese". *Wilson Bull.* Vol. 58, pp. 94–103.

Bent, Arthur Cleveland. 1925. 'Life histories of North American wildfowl, Order Anseres (Part)'. *U.S. Nat. Mus. Bull.* No. 130, x + 316 pp., 60 plates.

Delacour, Jean. 1951. 'Preliminary note on the taxonomy of Canada Geese, *Branta canadensis*'. *Amer. Mus. Novitates*, No. 1537, 10 pp.

Kumlien, Ludwig. 1879. "Birds" *in* 'Contributions to the natural history of arctic America made in connection with the Howgate Polar expedition, 1877–78'. *U.S. Nat. Mus. Bull.* No. 15, pp. 69–105. (Also issued in *Smithsonian Misc. Coll.* Vol. 23).

Manning, T. H. 1942. "Blue and Lesser Snow Geese on Southampton and Baffin Islands". *Auk,* Vol. 59, pp. 158–75.

Phillips, John C. 1925. 'A natural history of the ducks'. London: Vol. 3, ix + 383 pp.

1926. 'A natural history of the ducks'. London: Vol. 4, ix + 489 pp.

Soper, J. Dewey. 1928. 'A faunal investigation of southern Baffin Island'. *Nat. Mus. Can. Bull.* No. 53, 143 pp.

1946. "Ornithological results of the Baffin Island expeditions of 1928–1929 and 1930–1931, together with more recent records". *Auk,* Vol. 63, pp. 1–24, 223–39, and 418–27.

Sutton, George Miksch. 1931. "The Blue Goose and Lesser Snow Goose on Southampton Island, Hudson Bay". *Auk,* Vol. 48, pp. 335–64.

1932a. "The birds of Southampton Island" *in* 'The exploration of Southampton Island, Hudson Bay'. *Mem. Carnegie Mus.* Vol. 12, Part 2, Sect. 2, 275 pp.

1932b. "Notes on the molts and sequence of plumages in the Old-squaw". *Auk,* Vol. 49, pp. 42–51.

Todd, W. E. Clyde. 1938. "A new eastern race of the Canada Goose". *Auk,* Vol. 55, pp. 661–2.

Wynne-Edwards, V. C. 1952. "Zoology of the Baird expedition (1950). I. The birds observed in central and south-east Baffin Island". *Auk,* Vol. 69, pp. 353–91.

SOME INSTANCES OF UNSTABLE SURFACE TEMPERATURE CONDITIONS DURING AN ARCTIC WINTER*

Elmer Robinson†

Atmospheric conditions in which the air has a vertical temperature stratification such that portions tend to rise and become turbulent, are frequently observed in temperate climates. These turbulent conditions, in which the atmosphere is said to have an unstable or superadiabatic temperature gradient are commonly caused by solar heating of the earth's surface and the transfer of some of the earth's heat to the atmosphere. Such conditions produce the vertical transport of moisture evidenced by cumulus clouds.

Although the Arctic is generally characterized by a stable or quiescent atmospheric structure, unstable conditions[1] as shown by superadiabatic temperature gradients do occur. They were recorded during a field observational program at Eielson Air Force Base, near Fairbanks, Alaska. The fact that these conditions were observed in winter when the sun was at a very low angle above the horizon, and even on overcast days, led to a more detailed examination of the data to explain the cause of these phenomena. Although these turbulent or superadiabatic situations are much less frequent during the arctic winter than are inversions or stable conditions, they appear to be important in some arctic weather situations, of which ice fog is one example. Data on the occurrence of unstable surface temperature gradients will thus aid the description of various aspects of the weather in the Arctic and will show some of the complexities of northern weather.

Superadiabatic lapse rates were observed under several different general weather conditions. One, as might be expected, was during periods of strong insolation when the snow surface was in bright sun. Although the sun is quite low during much of the winter in the Fairbanks area, surface heating at about noon begins to be significant after the middle of February. Another condition which was observed to cause a superadiabatic situation was one in which a heavy overcast and an overriding air mass considerably warmer than

*This study represents a portion of a project dealing with Alaskan ice fog and supported by U.S. Air Force Cambridge Research Center under Contract No. AF19(122)-634.

†Stanford Research Institute, California.

[1]An unstable condition is one in which the air temperature decreases with increasing height at more than 1°C per 100 m. This unstable condition is also called superadiabatic because the rate of temperature change is greater than what would take place in a vertically moving air parcel under adiabatic conditions. An unstable condition favours the vertical movement of air parcels.

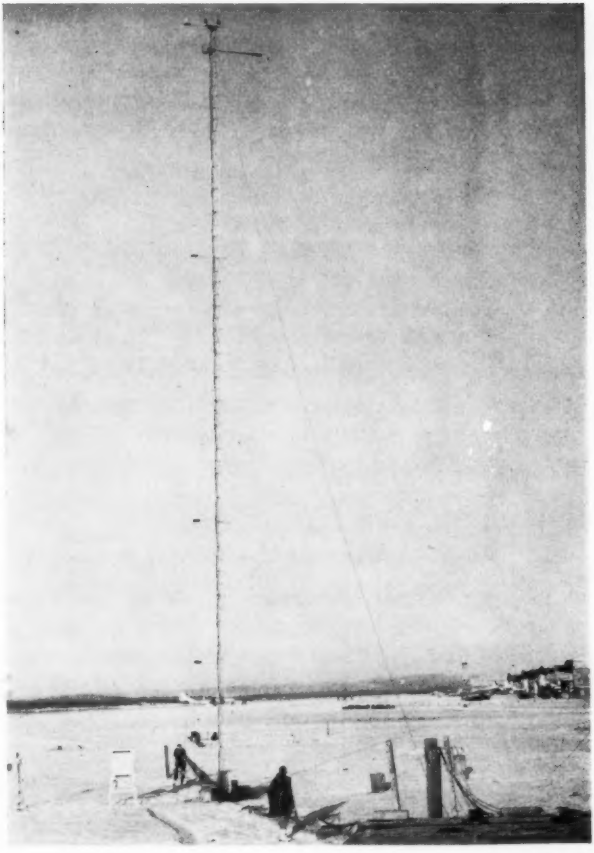

Fig. 1. Meteorological tower instrumentation, Eielson Air Force Base, Alaska, 1954.

the surface was present over the area. In this case it seems apparent that the warmer air mass aloft supplied the radiant energy which supported the super-adiabatic lapse rate at the surface. A third type of surface instability occurred during a large number of ice fog situations. This was apparently due to the "greenhouse" effect of the fog layer and thus was similar to the instability due to the overriding warm air mass.

Equipment

Observations of the atmospheric temperature structure were made using a tower equipped for recording the routine micrometeorological variables. This equipment has been described previously (Wiggins and others, 1954, pp. 99–102) but a brief description is warranted in the present discussion.

Figure 1 shows the tower and levels at which the various observations were made. The essential components of the recording system for the determinations of temperature gradients were copper-constantan thermo-

couples, a thermostated reference junction, a Weston "Inductronic" DC amplifier, and a multipoint Brown recording potentiometer. The thermocouples (except for the snow-surface thermocouple, which was unprotected) were shielded with sheets of polished aluminum patterned after Thornthwaite (1949, pp. 6–7). The data from the tower instruments related to the study of temperature gradients are:

1. Air temperature at 2 m.
2. Air temperature at 29 m.
3. Temperature difference between snow surface and 2 m.
4. Temperature difference between 5 m. and 2 m.
5. Temperature difference between 10 m. and 2 m.
6. Temperature difference between 20 m. and 2 m.
7. Temperature difference between 29 m. and 2 m.

The air temperatures were recorded directly by the Brown recorder, using the reference junction thermostated at 0°C. The temperature differences were amplified by the Weston amplifier before being recorded. Since

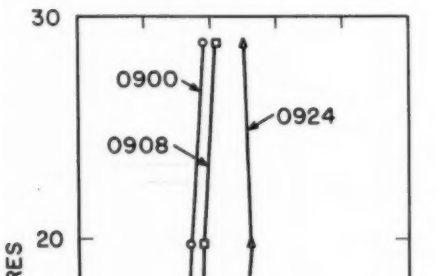

Fig. 2. Superadiabatic profiles, Eielson Air Force Base, 18 January 1954.

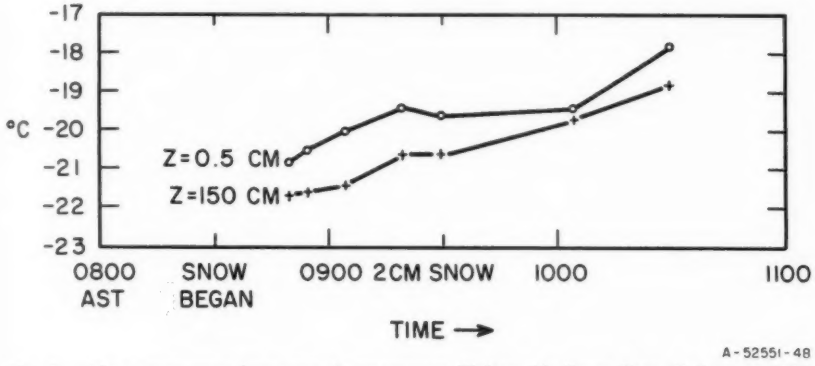

Fig. 3. Air temperatures from two thermometers, Eielson Air Force Base, 19 January 1954.

the snow was often at least 25 cm. deep, the distance between the surface thermocouple and the thermocouple at the 2-m. tower level was generally less than 2 m.

Observations under overcast conditions

On 18 January 1954 it was possible to make some special studies of an unstable situation that occurred with a heavy overcast and an overriding warm air mass. This situation lasted for at least 8 hours, with a moderate-to-heavy snowfall (for the Fairbanks area) during the last few hours and temperatures around -20°C.

Figure 2 shows the profiles through the first 29 m. as recorded by the micrometeorological equipment at 0900, 0908, and 0924 hours, local time, under heavy overcast from which snow was falling. The data show an unstable or superadiabatic condition to a height of 5 m., above which there was a weak inversion. Winds, during this half-hour period, were about 1 m.p.h. and about 1 cm. of very light fluffy snow accumulated while the measurements were being made. Total snow cover was about 20 cm. These observations are typical of the period during which the unstable conditions lasted.

This unstable condition was also studied with alcohol thermometers. Two thermometers (Cenco No. 19360, calibrated from 0° to -50°C in 0.2°C divisions) which had been checked and found to indicate the same temperature when hanging side by side in the open air, were used. One was placed next to the surface thermocouple with its bulb at the level of the thermocouple, about ½ cm. above the snow surface. The other thermometer was hung from the shield of the 2-m. thermocouple. The thermometer bulbs were 150 cm. apart and the thermocouples were 175 cm. apart. The readings of these two thermometers at various times between 0850 and 1030 hours are shown in Fig. 3. Temperatures rose by 3°C at both heights between the first observation at 0850 and the last at 1030. The maximum difference 1.4°C

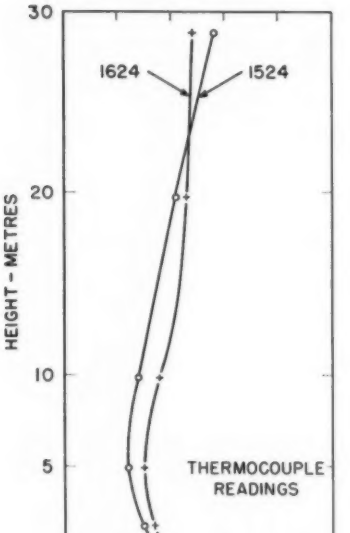

Fig. 4. Superadiabatic profiles, Eielson Air Force Base, 19 January 1954.

was recorded by the thermocouples at 0905 and is similar to the 1.6°C difference recorded by the thermocouples.

The heavy overcast conditions changed little during the rest of January 18 and persisted through the following day. Fig. 4 shows the conditions on January 19 at 1524 and 1624 hours. The surface lapse conditions up to a height of 5 m. were not as strong as on the previous day and the temperatures at all levels had risen several degrees. The inversion above 5 m. was steeper.

To maintain this observed superadiabatic surface layer the surface had to be receiving energy from some source, and it seems evident that during these two days the source was the warm cloud layers aloft. The temperatures in these cloud layers, as recorded by the Fairbanks Weather Bureau upper air observations for 0500 on January 18 and 19, are shown in Fig. 5. On the 18th the warmest air (-5°C) was found at around 1,500 m. whereas on the 19th the warmest layer (-11°C) was at around 300 m. These upper air temperatures at Fairbanks are the only ones available for this period but were probably fairly representative of the conditions over the laboratory at Eielson AFB, 30 miles away and several hours later in the day. Even though the surface temperatures varied by a number of degrees the upper level conditions would not be expected to show similar variations.

As Fig. 1 shows, the tower was equipped to record the net radiation at heights of 2 and 29 m. During the observation period on January 18, the net radiation was measured as incoming from 166 to 332 x 10^{-6}cal./cm.^{2}/sec. at

the 2-m. level. These data substantiate the explanation that the unstable conditions were due to incoming radiation at a time when, because of the heavy overcast, the warmer cloud layers were the only apparent source of radiation.

Observations under diurnal insolation conditions

Unstable conditions due to insolation on the surface could be observed on almost any clear day at Eielson AFB after early February. Fig. 6 shows a typical progression from inversion or stable to unstable and back to inversion conditions as a result of the diurnal insolation cycle. These data are hourly average temperatures recorded at the tower installation on 19 February 1954. The 0600 hours data, average values for the period 0530 to 0630, show a 1.5°C increase or inversion in the first 2 m., near isothermal conditions between the 2 and 10-m. levels, and a stronger inversion in the levels between 10 and 29 m. The isothermal level was doubtless associated with the presence of a shallow ice fog during this period. This type of profile was fairly typical of a shallow fog. By 0900 a very weak superadiabatic layer was evident in the lowest 2 m., although there was only a -0.5°C change in temperature. During the period 0830 to 0930 hours, which was averaged for the 0900 data, the ice fog had disappeared along with most of the stability which characterized the surface to 28-m. air layer during the 0600 period. The average data show that by 1200 hours a more unstable surface condition had developed, temperatures were almost 15°C warmer than those recorded at 0600, and considerable warming had occurred at all levels. The reason for the "sand-

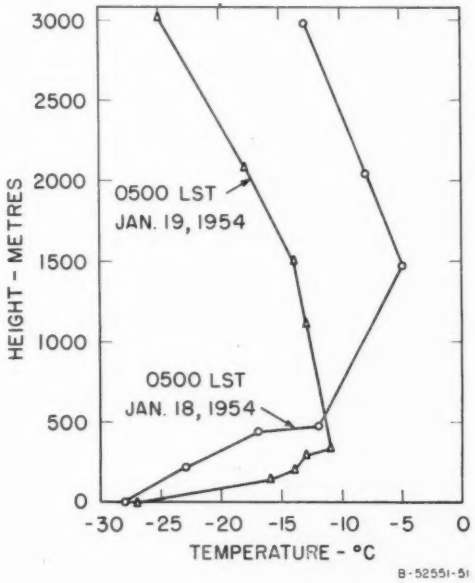

Fig. 5. Radiosonde observations, Fairbanks, Alaska.

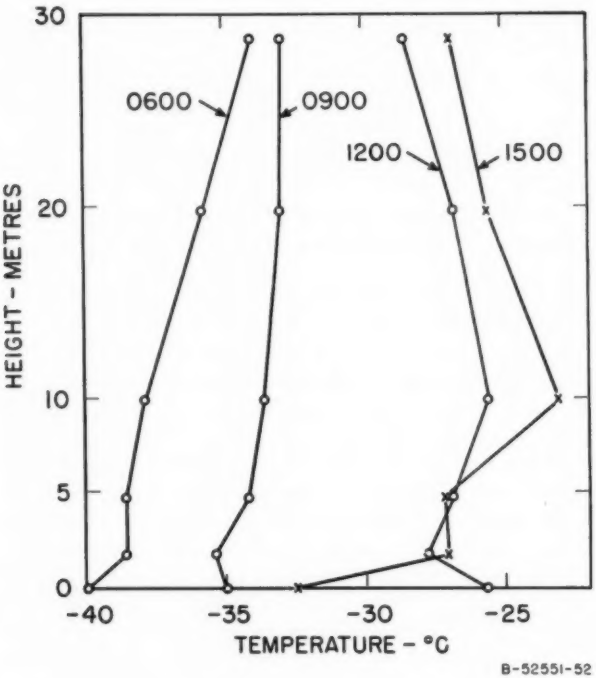

Fig. 6. The development of unstable conditions through insolation, Eielson Air Force Base, 19 February 1954.

wich" type of profile (the inversion bounded by two unstable layers) is not clear. However, a review of the data indicated that it was a recurrent feature and not a transitory situation. By 1500 hours the lowest level again showed an inversion which was over 5°C in magnitude. An unstable condition, which seemed to be a remnant of the earlier condition, was maintained between 10 and 29 m. The cycle continued in a more or less regular manner during the remainder of the day, with increasing stability in the surface layers.

Net radiation measurements during this period of insolation indicated a maximum of incoming radiation between 1100 and 1200 hours and maximum of outgoing radiation between 1400 and 1500 hours, after which it gradually decreased through the rest of the afternoon and evening. This pattern of radiation was frequently observed; it seems to have been caused by the following sequence of events. First, the period of positive, net incoming radiation around noon was a result of direct insolation. This positive radiation not only warmed the surface, but promoted the clearing of the atmosphere of smoke and fine particles through thermal turbulence, as is shown by the unstable or superadiabatic conditions, and by thermally-induced local winds. The second phase, the rapid radiation loss by the surface, occurred with a decrease in the insolation in the early afternoon and was facilitated by the clear atmosphere. The third phase of the radiation cycle, the decrease of the net outgoing radiation, occurred as the surface radiational inversion

became re-established and was accompanied by a gradual accumulation of smoke and particulates. This produced an atmosphere less transparent to radiation from the surface and in severe cases, such as ice fog, the surface radiation was interrupted so much that the surface inversion was again destroyed.

Observations during ice fog

The data for 0600 in Fig. 6 show the tendency toward instability during ice fog. This type of profile is caused by the absorption and re-radiating characteristics of fog, which restrict the ground surface from acting as a radiating surface and, instead, the top of the fog layer becomes the principal radiator. This tends to produce lapse conditions in the levels beneath the top of a fog and a steeper inversion above fog (Fleagle and others, 1952). Since studies of ice fog have shown that it is almost exclusively confined to inhabited areas, this instability situation seems to be of minor importance with regard to arctic climatology in general, although it is of interest in the problem of ice fog itself and in the microclimate of urban areas in the Arctic.

Seasonal conditions

The frequencies at which various lapse rate conditions occurred in the surface to 2-m. and 2 to 5-m. levels are shown in Table 1, taken from hourly average data taken between 1 January and 28 February, 1954. A summary

Table 1. Frequency combinations of temperature differences and air temperature at a height of 2 metres. Hourly average data for the period 1 January to 28 February 1954, Eielson Air Force Base, Alaska.

		2 metre air temperature °C						
	Temp. difference °C T (surface) to T (2 m.)	*Below −40*	*−40.0 to −35.1*	*−35.0 to −30.1*	*−30.0 to −25.1*	*−25.0 to −20.1*	*−20.0 to −15.1*	*−15.0 to −10.1*	*Total*
Stable	Below −9.50				8	4			12
	−9.50 to −8.51		1	3	6	7	1		18
	−8.50 to −7.51			14	14	7	2	1	38
	−7.50 to −6.51		5	12	15	2	4	2	40
	−6.50 to −5.51		11	10	29	11	3	2	66
	−5.50 to −4.51		22	14	21	15	4	5	81
	−4.50 to −3.51	3	34	20	23	23	9	5	117
	−3.50 to −2.51	10	38	11	26	36	16	17	154
	−2.50 to −1.51	15	44	6	30	27	7	15	144
	−1.50 to −0.51	9	38	10	33	13	19	26	148
	−0.50 to 0.0	3	13	7	15	14	37	31	120
Unstable	+0.01 to +0.50	1	8	4	23	7	27	18	88
	+0.51 to +1.50		12	9	24	32	50	31	158
	+1.51 to +2.50	1	10	10	8	12	15	4	60
	+2.51 to +3.50		5	11	8	4	2		30
	+3.51 to +4.50		1	2	4	1		1	9
	+4.51 to +5.50		1	2	1			2	6
	Total	42	243	145	288	215	196	160	1289
	Temp. difference T (2 m.) to T (5 m.)								
Stable	−5.50 to −4.51				3			2	5
	−4.50 to −3.51	2	11		1	1	1	1	17
	−3.50 to −2.51	3	15	10		4	3		35
	−2.50 to −1.51	3	45	25	25	6	6	3	113
	−1.50 to −0.51	10	59	49	106	78	40	26	368
	−0.50 to 0.0	3	47	28	107	89	82	85	441
Unstable	+0.01 to +0.50	7	27	13	39	29	50	26	191
	+0.51 to +1.50	13	45	21	10	1	13	16	119
	+1.51 to +2.50	1	3						4
	Total	42	252	146	291	208	195	159	1293

of the data shows that decreasing temperatures occurred in the 0 to 2-m. layer 27 per cent of the time and actual superadiabatic conditions 20.4 per cent. A decrease in temperature with height in these shallow layers is practically equal to an unstable condition, although by definition an unstable condition would have a temperature decrease in excess of 0.02°C in the 0 to 2-m. layer. Temperature decreases equal to 0.01°C per metre are actually neutral, neither stable nor unstable, but have been tabulated with the unstable conditions. Inversions with lapse rates less than -0.5°C occurred 63.4 per cent and 41.3 per cent of the time in the 0 to 2-m. and 2 to 5-m. layers, respectively.

Table 2. Percentage of time during which temperature decreases occurred in the surface to 2-metre level and the 2 to 5-metre level. Hourly average data for the period 1 January to 28 February 1954, Eielson Air Force Base, Alaska.

	2 metre temperature °C						
Levels	*Below −40.0*	*−40.0 to −35.1*	*−35.0 to −30.1*	*−30.0 to −25.1*	*−25.0 to −20.1*	*−20.0 to −15.1*	*−15.0 to −10.1*
Surface to 2 m.	4.8	15.2	26.2	23.6	26.0	48.0	35.0
2 m. to 5 m.	50.0	30.0	23.3	16.8	14.4	32.3	26.4

The distribution of the decreasing temperature conditions with respect to 2-m. ambient temperature is shown in Table 2. The unstable conditions at temperatures below -30°C probably resulted largely from the "greenhouse" effect of ice fog, since at these temperatures the fog was almost always present. Lapse conditions at warmer temperatures would be expected to be due principally to insolational heating, although the warm-layer radiation type would also occur in this warmer temperature range. From Table 2 it appears that at the lower temperatures the unstable conditions were more often found above the surface layer, in the 2 to 5-m. layer, whereas at temperatures between -30°C and -10°C an unstable 0 to 2-m. layer was more general. This latter situation can doubtless be attributed to the insolation type of instability usually found in the warmer temperature range. Although there does appear to be an indication of less frequent unstable conditions in the 0 to 2-m. layer at colder temperatures, a single year's data are not sufficient basis for any firm conclusions. Data from other arctic areas and collected over a number of winter seasons are needed to clarify these stability relationships.

The frequencies of unstable temperature conditions through successively thicker strata to the top of the tower are shown in Table 3. This tabulation differs slightly from Table 1 for the 2 to 5-m. layer by excluding positive

Table 3. Frequency of occurrence of unstable temperature conditions ($\triangle T/\triangle H \leq 0.01°$ C./m.) through several layers. Hourly average tower data, 1 January to 28 February 1954, Eielson Air Force Base, Alaska.

Levels	*% Unstable*	*Remarks*
Surface to 2 m.	27	$T(0) - T(2) > 0°C$
2 m. to 5 m.	23	$T(2) - T(5) > 0.03°C$
2 m. to 10 m.	11	$T(2) - T(10) > 0.08°C$
2 m. to 20 m.	5	$T(2) - T(20) > 0.18°C$
2 m. to 29 m.	10	$T(2) - T(29) > 0.27°C$

temperature differences less than 0.03°C, which being less than the dry adiabatic condition, are stable conditions. The Table 3 data indicate that unstable lapse rates are most frequent in the surface to 2-m. layer and least frequent in the layer between 2 m. and 20 m.

A superadiabatic or unstable atmospheric condition requires a continuous source of energy to perpetuate itself. In the present instances the source of energy was apparently incoming radiation absorbed by the snow surface and then transferred, or radiated, to the lower levels of the atmosphere by conduction and absorption. It seems most likely that conduction was the principal mechanism except in the presence of fog aerosols, in which case the particles probably played a significant role in the absorption of long wave radiation from the surface. The albedo or reflectivity of the snow surface is undoubtedly a factor which must be considered in these problems of radiation. In the present instances the snow surface was generally not fresh but was often dirty and crusty, particularly during February. This surface condition produces a lower albedo value and a surface more conducive to surface heating than fresh snow.

Of the unstable surface conditions discussed, the insolation type is doubtless the most important in the arctic climatological regime. Under such conditions the snow can disappear rapidly even though the temperature may never approach the melting point. Since the unstable conditions permit the rapid transport of water vapour out of the surface layers, this provides a mechanism quite favourable for the ablation of the snow cover. The turbulent condition generated by a warm air mass aloft would have to be frequent to be an important feature of the arctic climate, but even with limited occurrences it may be of value in understanding some micrometeorological processes in both arctic and temperate regions. The observation of instability within an ice fog layer helps to explain the phenomenon and must be taken into consideration when any amelioration of ice fog situations are proposed. However, ice fog is a product of human habitations under special arctic conditions, and the lapse rates associated with it are restricted to urban areas.

The assistance of the U.S. Air Force at Eielson AFB and of the Stanford Research Institute Ice Fog Project personnel is gratefully acknowledged, in particular that of Gordon B. Bell, who supplied the figures and the data tabulations given here.

References

Fleagle, R. G., W. H. Parrott, and M. L. Barad. 1952. "Theory and effects of vertical temperature distribution in turbid air". *J. Meteorol.* Vol. 9, pp. 53–60.

Thornthwaite, C. W. 1949. 'Micrometeorology of the surface layer of the atmosphere'. Interim report No. 6 and No. 7, John Hopkins Univ. Lab. of Climatology.

Wiggins, E. J., E. Robinson, W. C. Thuman, G. B. Bell, and G. A. St. John. 1954. 'An investigation of the ice fog phenomenon in the Alaskan area'. Report No. 21, Stanford Res. Inst., Project CU-473.

CROSSING NORTH PEARY LAND IN SUMMER 1953

E. J. Fränkl*

NORTH Peary Land, the most northerly part of Greenland, is a large peninsula bounded on the east and north by the Arctic Ocean, and on the south by Frederick E. Hyde Fjord and its western prolongation, a deep valley leading to Harder Fjord. It is crossed from east to west by a mountain range, 60 to 70 km. wide, which contains alpine peaks 6,300 feet high. The valleys are mainly occupied by glaciers, but there are large ice-free areas on the north coast and the shores of Frederick E. Hyde Fjord.

Since 1900, when Peary journeyed along the north coast of Peary Land and discovered Kap Morris Jesup, the area has been visited by several explorers and scientists. J. P. Koch reached the east coast of north Peary Land in 1907, and in 1909 MacMillan and Borup visited Kap Morris Jesup. In 1921 Lauge Koch led the Danish Jubilee expedition round the north coast, making scientific observations from which a geological map of Peary Land was drawn. Since then Danish expeditions to east and north Greenland have been frequent, and a program of mapping and geological surveying has been carried out. This was continued by the Danish East Greenland expedition 1953, under the leadership of Lauge Koch, which was composed of geologists working in east Greenland from the base on Ella Ø, 73°N., who included J. Haller, studying the Caledonian metamorphics at the edge of the ice cap; E. Wenk and P. Bearth, mapping plutonic centres in Scoresby Land; H. Butler, continuing his studies of the Devonian, and M. Sommer working in Lyells Land. In addition two groups of geologists worked in north Greenland from the base at Centrumsø, 80°N. They were P. Adams and J. Cowie, mapping the Danmarks Fjord region, and F. Müller and the writer with a twofold plan of work: to complete the geological map started the previous year, in Kronprins Christians Land, and to cross north Peary Land, making a geological reconnaissance. This journey was made during the first part of our field season.

From 1948 to 1951 I had been studying the structure of the Caledonian mountains of central east Greenland and in 1952 both Müller and I had worked from the base at Centrumsø, Müller studying the arctic soils while I continued geological mapping. However, the unknown interior of north Peary Land interested us greatly, and during the winter we worked out a plan to cross the peninsula, based on a thorough study of aerial photographs which were kindly made available to us by Colonel Helck, Geodætisk Institut, Copenhagen. As Catalina and Norseman aircraft (on floats) are the main form of transport on Lauge Koch's summer expeditions it was essential to

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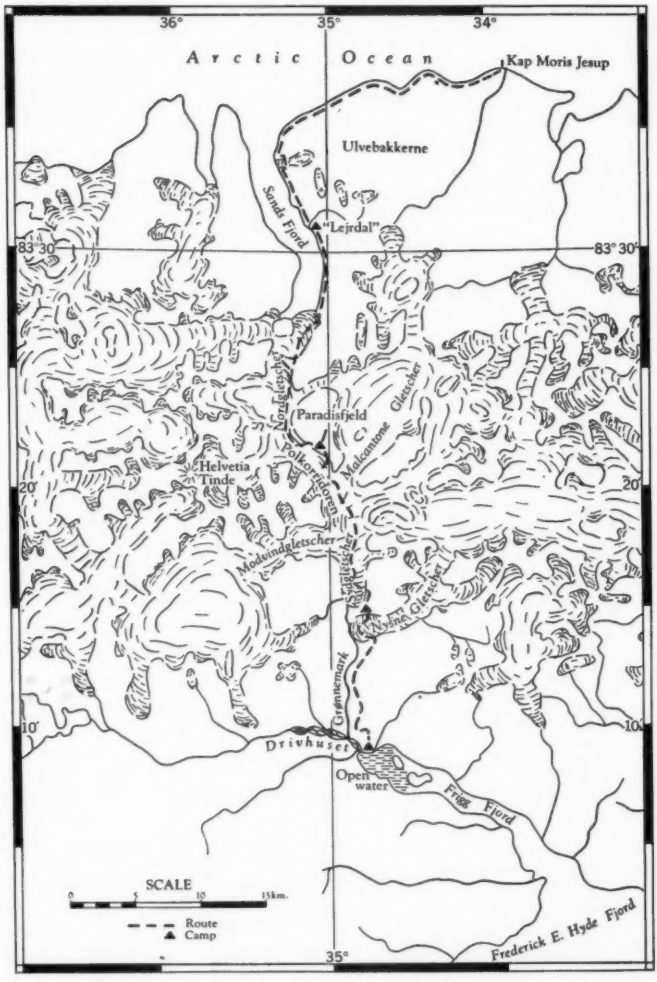

Fig. 1. North Peary Land showing the route followed to Kap Morris Jesup.

find open water for landing at the starting point of our journey. From the air photographs we concluded that the only place in north Greenland that would be free of ice every summer was the head of Frigg Fjord, a small side branch of Frederick E. Hyde Fjord (Fig. 1). Lauge Koch had seen this fiord from the air in 1938 and had named the area Drivhuset (hot house). The distance from Centrumsø to Frigg Fjord was farther than the loaded Norseman could fly with safety, and the use of the Catalina was impossible owing to the high cost. The problem of transport to Frigg Fjord was solved on August 1 when permission was obtained to call at the Danish-American airfield, Nord, for refuelling and so the Norseman could be used.

We wasted little time packing our equipment and took off almost immediately for Nord, where we were most hospitably received. We departed from Nord at midnight, and our pilot, Hans Lunding, headed the aircraft over Independence Fjord towards Peary Land. For some time heavy mist prevented us from determining our position, and it was not until we reached the outer part of Frederick E. Hyde Fjord that conditions improved. At 2.30 a.m. on August 2 we put down on the ice-free waters of Frigg Fjord (Fig. 2). The aircraft left shortly after, the pilot having arranged to return for us on August 10 at 6 p.m.

Towards midday Müller and I started walking northward, both carrying heavy loads. After crossing the desert-like delta cones and gravel terraces of the interior of Frigg Fjord, we entered a deep, northward-ascending valley. To our surprise there was a dense vegetation cover of *Cassiope tetragona*, *Dryas integrifolia*, and *Salix arctica*, and we decided to call the valley Grønnemark (Green country). A large glacier, the Nysne Gletscher (New Snow Glacier), forms a barrier across Grønnemark, and from its crest we had an impressive view of high peaks farther north. Beyond the Nysne Gletscher a broad glacier, Sydgletscher, flows down the valley and we set up camp at its foot. On August 3 we went up the Sydgletscher. The surface was composed of small ridges 3 to 10 feet high, and walking was difficult until we found a good path along a stream bed. Before long the weather began to turn stormy, and snow was falling by the time we reached the pass Polkorridoren (previously known as "Nordpassagen"). Here we had the choice of following the Malcantone Gletscher, on our right, northeast to another more distant pass, or of following the large Nordgletscher, on our left, down a steep-walled valley. We decided to take the latter route because the rock walls promised good geological opportunities. On the way we encountered several large streams flowing in deep ice gorges which were difficult to cross (Fig. 3). Later we managed to cut steps down the glacier flank, and made our second camp on the beach of a small blue lake (Fig. 4).

Next day, August 4, was sunny, and after climbing up about 600 feet from camp we enjoyed a wonderful view of mountains to the north, including Helvetia Tinde, 6,500 feet, the highest mountain in north Greenland. Travelling down Nordgletscher we met the same problems as on the Sydgletscher, and again the only passable route was along the surface rivers. We were able to avoid a large, highly crevassed bend of the glacier by following a steep canyon which descended almost to sea level. After eight hours walking we reached the head of Sands Fjord, which opens into the Arctic Ocean. Until now we had encountered no serious difficulties, but the east coast of Sands Fjord was one long obstacle course. The mountainous sides rise steeply, with only a narrow strip of boulder and scree at the water's edge. It took us six more hours to reach "Lejrdal" (Camp valley) delta, which we had chosen as the base for our journey to Kap Morris Jesup.

We set out towards the cape in the early evening on August 5, hoping to make the journey there and back (about 60 km.) in sixteen to twenty hours. We spent all that evening, all the next day, and the early hours of

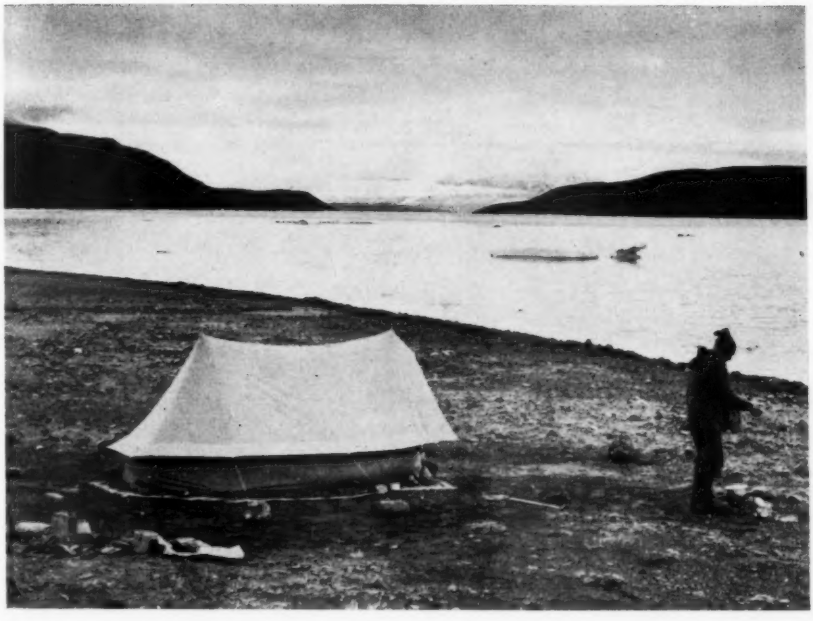

Fig. 2. The ice free water of Frigg Fjord.

Fig. 3. Ice gorge on Nordgletscher. In the background, the pass Polkorridoren.

Fig. 4. View down Nordgletscher from our camp near the pass.

August 7 walking. Along the shore of Sands Fjord there was a strip of boulders similar to that encountered previously; in addition, near the entrance to the fiord we came upon a steep glacier dropping almost vertically into the water. We climbed the rock wall on the southern edge of the glacier until, at about 700 feet, we came to a flat ledge where we could cross the glacier and climb down on the north side. When we finally left the fiord and turned east we found that the ice foot, on the shores of the Arctic Ocean, provided an excellent uninterrupted route for several miles. About this time Müller observed a large animal following us; it was a white polar wolf, now very rare in Greenland.

On August 6, at 8.45 a.m., we reached the cairn on Kap Morris Jesup. Inside the cairn we found a tin containing the *Danebrog*, the Danish flag, and after some searching, another tin containing Lauge Koch's report made in 1921. We copied this, made some additional notes, placed the copy and notes in the cairn, and took the original report away with us. We made

observations on the geology, zoology, botany, and weather conditions. Once again the flora was impressive; here about 700 km. from the north pole, we found a closed moss vegetation and about twenty different higher plants, including *Saxifraga flagellaris, S. caespitosa, S. oppositifolia, Papaver radicatum, Cochlearia officinalis, Epilobium latifolium, Melandrium apelatum, Arenaria (?)rubella, Cerastium alpinum, Alopecurus alpinus, Carex incura*, and *Deschampsia* spec. We started back at midday, and reached our base camp in Sands Fjord early in the morning on August 7.

We were very tired and rested until late that night before setting out for our camp near the pass. As we walked we tried to fill some details into the rough geological picture obtained on the journey to the north coast. We halted frequently to collect geological samples, and the weight of the food we had carried out and eaten was more than replaced by the specimens. It was 2 a.m. on August 9 when we reached our camp site between the Sydgletscher and Nysne Gletscher. The weather was unfavourable, and the dense mist forced us to stay in the tent for twenty-four hours. Our last provisions were eaten, and we were very glad when, on the 10th, a strong wind cleared the mist. We covered the last stretch to our camp in Frigg Fjord quite quickly, arriving at 3 p.m. on August 10, three hours before our appointment with the aircraft. Unknown to us bad weather had prevented Hans Lunding from flying and we spent an anxious time waiting for him. We had little food left at camp, because of the weight limit of 75 kg. for all our equipment when we flew in. However this situation was known, and around midnight on August 12 the Catalina "Pluto", commanded by Captain Pedersen with Lauge Koch himself on board, managed to put down on Frigg Fjord. As we took off and headed along Frederick E. Hyde Fjord, clouds closed in over Frigg Fjord, and we flew to airfield Nord over thick clouds.

Our purpose, to make a geological cross-section of north Peary Land, was fulfilled, although most of the data were collected on the march carrying heavy loads. A summary of the geological results is appended. A detailed report is to be published elsewhere, in German with an English summary[1], and a paper linking our observations with the latest geological results from Ellesmere Island is in preparation.

Summary of the geology of north Peary Land

The mountains of north Peary Land are part of the belt of Caledonian folding that extends from north Ellesmere Island to north Greenland. The rocks range in age from Precambrian to Upper Silurian, although in Ellesmere Island the Devonian is also reported to have been affected by late orogenic movements.

In south Peary Land unfolded Carboniferous and younger strata lie discordantly above the Silurian. Our section (Fig. 5) through north Peary Land only showed strongly folded rocks, some of which had been

[1]Fränkl, E. 1955. 'Rapport über die Durchquerung von Nord Peary Land (Nordgrönland) im Sommer 1953'. *Medd. om. Grønl.* Vol. 103, No. 8 (In press).

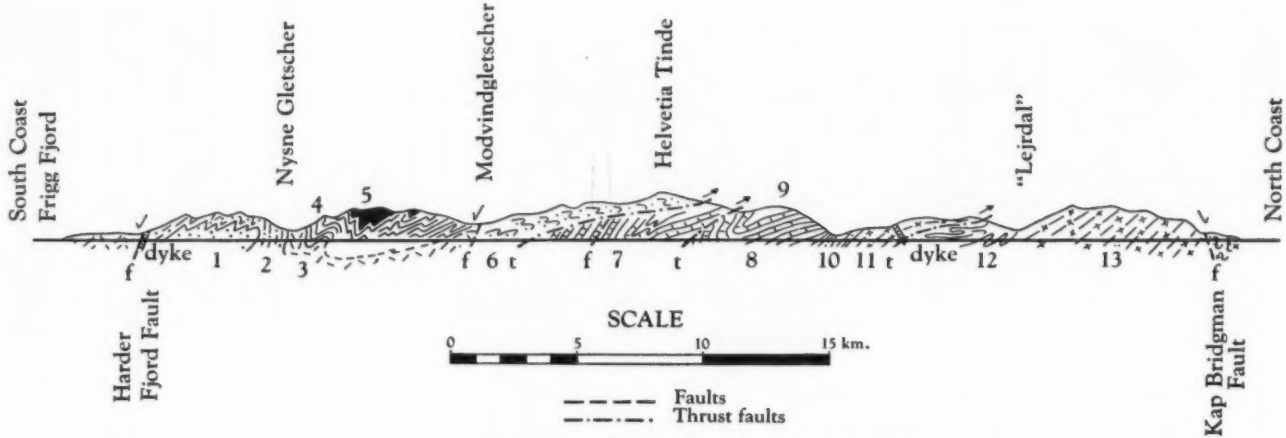

Fig. 5. Schematic cross-section through north Peary Land.

Stratigraphy

1. Grønnemark sandstones (1,000 m.+). Coarse-grained, light coloured sandstones and arkoses with layers of dark shales. **2.** Grønnemark shales (*ca.* 500 m.). Red shales and graphitic shales, slightly hardened, alternating with sandstones and limestones. **3.** Frigg Fjord mudstones (*ca.* 400 m.). Red and green shaly mudstones with (?)volcanic bombs. **4.** Nysne Gletscher graphitic slates (*ca.* 750 m.). Arenaceous slates with high graphite content above about 300 m. of unknown lithology. At the base slates alternates with limestones, which are gradually replaced above 300 m. by sandstone. Nysne Gletscher graphitic slates are considered to be slightly altered graptolite shales. They have been tentatively correlated with the Cape Tyson formation (Niagaran) of western north Greenland. **5.** Sydgletscher sandstones (300 m.+). Marly, micaceous, grey sandstones, weathering greenish and yellowish. The Sydgletscher sandstones have much in common with the Polaris Harbour formation which follows above the Cape Tyson formation. **6.** Polkorridoren series (800 m.+). Lithology unknown. Hard, layered, grey or dark green rocks lying as a nappe, thrust towards the north, on marbles and phyllites. **7.** Strongly disturbed zone of dark marble and rusty-weathering phyllite; the latter sometimes contain graphite. **8.** Marbles alternating with rusty-weathering phyllites. **9.** Yellowish-weathering series, lithology unknown. **10.** Quartzitic, fine-grained slates. **11.** Sands Fjord quartz-phyllites. Some gneiss layers were found in this series and are thought to be altered arkoses. **12.** Ulvebakkerne marbles. Light coloured marbles with thin layers of rusty-weathering phyllites, both intensely folded. **13.** Kap Morris Jesup quartz-phyllite. Salty, micaceous quartzites and sandy mica-schists with some garnet-bearing layers.

metamorphosed. These rocks may be divided into two zones by a line which crosses Polkorridoren. To the south there are slightly metamorphosed, strongly folded sediments, whilst on the north side the amount of metamorphism increases rapidly towards Kap Morris Jesup. It is assumed, therefore, that the centre of the geosyncline today lies beneath the Arctic Ocean. The strong compression in the northern part has led to overthrusts, some of which attain nappe-like dimensions. In contrast with the Caledonian zone of east Greenland, the overthrusts are directed towards the centre of the folding belt. Faults with downthrow on the south side and WSW.–ENE. strike, were formed in late or post-orogenic time. Younger faults trend W.–E. or WNW.–ESE., and their pattern largely controls the present topography; the two most important fault lines are the Harder Fjord in the south and Kap Bridgman fault in the northeast. North Peary Land was uplifted as a block between these two faults in preglacial time, and the landscape of today has developed from this initial relief, modified by local glacial erosion.

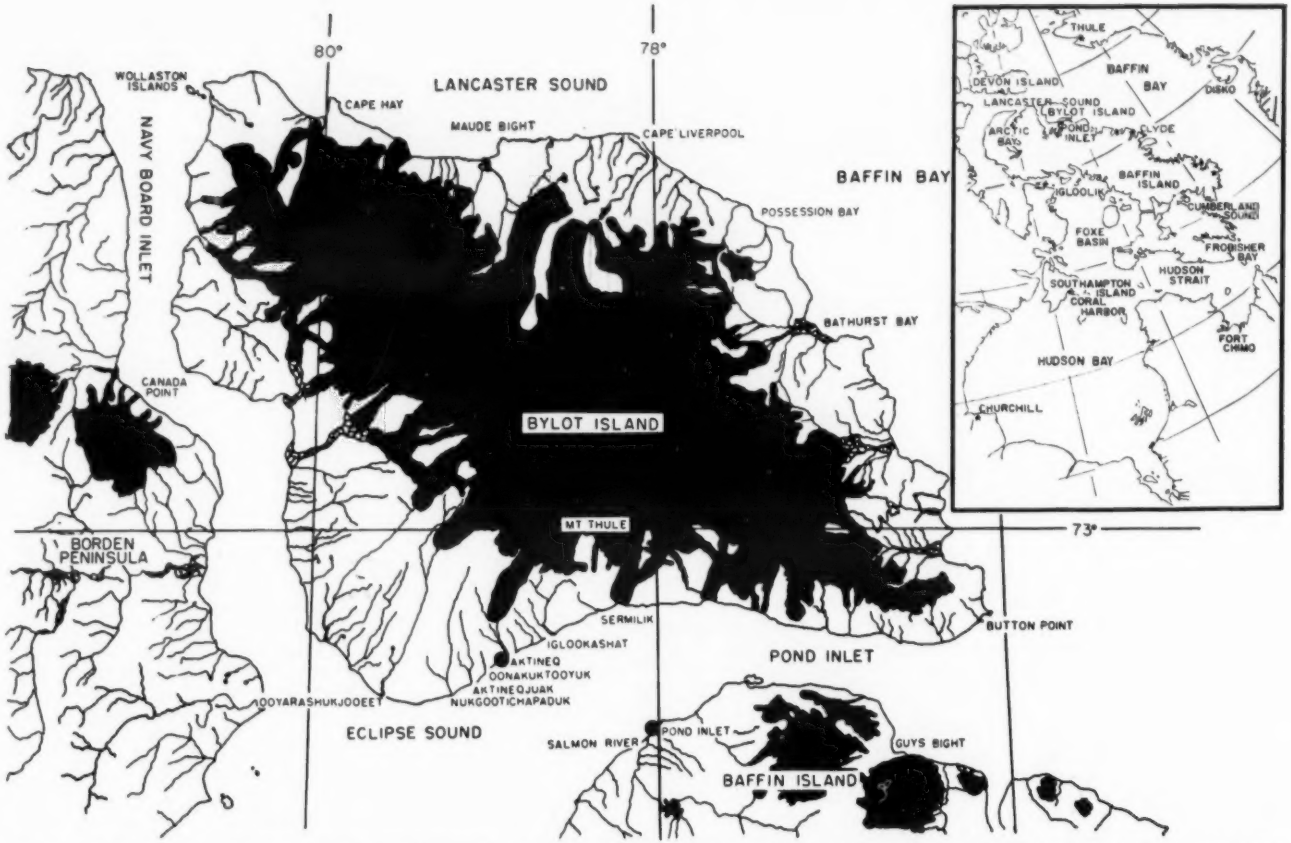

Fig. 1. Bylot Island, scale 1° longitude approximately 20 miles. Glaciers and snowfields shaded black. Black dots mark the expedition's camp site at the mouth of the Aktineq River, and the Hudson's Bay Company trading post at Pond Inlet, Baffin Island.

A SURVEY OF THE MAMMALS OF BYLOT ISLAND, NORTHWEST TERRITORIES

Richard S. Miller*

THE 1954 Bylot Island expedition was organized under the auspices of the Arctic Institute of North America, with additional support from the New York Zoological Society, to survey the flora and fauna of Bylot Island, and to study certain ecological problems. A general description of the activities of the expedition has been prepared (Drury, 1954) but the present paper reports only on the mammals of Bylot Island and its surrounding waters. It is based mainly on observations made in the field by the writer and other members of the expedition; data were also obtained from Arctic Wildlife Enquiry reports prepared by the Pond Inlet Detachment of the Royal Canadian Mounted Police, and the fur returns of the Hudson's Bay Company were made available to us. Discussion with the Tununermiut Eskimo proved most valuable, as they are accurate and reliable observers and could provide information on all seasons. Experience showed that certain Eskimo were better informed than others about particular animal species, and every attempt was made to take advantage of this.

Most of the Eskimo live on the shores of Pond Inlet, Eclipse Sound, Tay Sound, and Navy Board Inlet. There is one permanent camp at Iglookashat on Bylot Island, and a summer camp at Button Point. Hunting and trapping is confined mainly to Baffin Island and the south coast of Bylot Island, but occasionally the Eskimo travel as far north as Lancaster Sound and the Wollaston Islands, and to Maud Bight on the northeast coast of Bylot Island. They trade at Pond Inlet and make it their summer headquarters, so they were available for frequent questioning.

Idlouk, the most energetic and skilled hunter of the Tununermiut group, was attached to the expedition during our stay. His written notes on the annual abundance, migrations, and general habits of various animal species were extremely valuable.

Bylot Island is about 4,000 square miles in area, and is separated from Baffin Island by the waters of Pond Inlet, Eclipse Sound, and Navy Board Inlet (Fig. 1). The surface of the island consists mainly of rocky peaks projecting through highland ice (Fig. 2), and the only extensive lowlands are on the southwest and northeast coasts. A central mountain range forms a broad ridge along the axis of the island, stretching from Wollaston Islands in the northwest to Button Point in the southeast.

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Photo: R.C.A.F.

Fig. 2. View east from Canada Point.

The expedition camp was established on lowland on the south shore of the island, just west of the mouth of the Atkineq'River, on 14 June 1954, and maintained until July 31. Observations were made at points along the south coast from Button Point to Ooyarashukjooet. During the frequent crossings between the Bylot Island camp and Pond Inlet, a distance of about twenty miles, and on other dog sled trips on the sea ice of Pond Inlet and Eclipse Sound, observations on aquatic mammals were possible.

The vegetation of the south coast, the only area visited by the expedition, varies with the topography, exposure to sun and wind, and frost action. The dominant vegetation is *Salix arctica, Dryas integrifolia,* and *Luzula confusa. Luzula confusa* is particularly abundant on exposed, well-drained soils, where it forms a complex with *Saxifraga oppositifolia, Papaver radicatum,* and the lichens *Stereocaulon* and *Cetraria.* Sheltered areas with more moisture have

heavier growths of mosses and *Cassiope tetragona,* while the exposed, wind-blown areas and extremely well-drained soils are characterized by lichens, *Papaver saxifraga,* and *Salix. Salix herbacea* is characteristic of places sheltered from wind and sun, where snow tends to accumulate and remain for a long time.

Lemming mounds are the centres of a distinct vegetation complex. Progressive burrowing into solifluction lobes, frost cracks, and at the bases of boulders, and the accumulation of fecal material seems to contribute to a lush, grassy vegetation.

Mammal species

The Tununermiut names for the animals have been listed for the convenience of others who might study in this area. These names were provided by the Pond Inlet Eskimo, through Peter Murdoch, of the Hudson's Bay Company, who interpreted their references and spelling.

Species determinations were, in most cases, made directly from field observations with reference to Burt and Grossenheider (1952). Species not actually observed by members of the expedition were identified by the Eskimo from the illustrations in Burt and Grossenheider. Repeated tests showed that such identifications were extremely accurate and that even subtle specific differences were noted. The specific names used are those listed by Miller and Kellogg (1955).

Thalarctos maritimus. Polar Bear. *Nanook.*

Polar Bear are known from the Wollaston Islands east along the north coast of Bylot Island and along the east coasts of Bylot and Baffin islands. The relative abundance of this species is difficult to determine, since bears are seldom hunted anywhere but at the floe edge of Pond Inlet. The total annual kill by the Pond Inlet Eskimo is estimated at about 20 to 25, but as the hides are rarely traded there is no reliable index of numbers. Idlouk says that more bears could be taken if the hunters were to go farther afield and search for them.

Mustela erminea. Short-Tailed Weasel. *Tereak.*

According to the Eskimo, weasels are common along the southern coast and on the lowlands between Canada Point and Iglookashat. Several were seen by members of the expedition, usually near river beds, but once at an altitude of 3,500 feet at the edge of Sermilik Glacier.

Alopex lagopus. Arctic Fox. *Terereneak.*

This species is found throughout the lowlands of Bylot Island and is particularly abundant along the southern coast.

Table 1 shows the number of fox trapped annually by the Pond Inlet Eskimo for the past thirty-two years. These data are from the Hudson's

Bay company fur returns, in which a season is the period from July 1 to June 30 of the next year. The estimates of lemming abundance are from Arctic Wildlife Enquiry reports. The records for both fox and lemming are illustrated graphically in Fig. 3.

Table 1. Seasonal abundance of arctic fox and lemming in the Pond Inlet area.

Season	*Arctic Fox*[1]	*Lemming*
1921–22	318	
1922–23	1048	
1923–24	1355	
1924–25	312	
1925–26	1105	
1926–27	1866	
1927–28	844	
1928–29	382	
1929–30	1333	
1930–31	3515	
1931–32	2384	
1932–33	479	
1933–34	2811	
1934–35	3113	
1935–36	904	
1936–37	450	
1937–38	1698	
1938–39	971	very abundant
1939–40	700	very abundant
1940–41	844	very abundant
1941–42	933	scarce
1942–43	1020	scarce
1943–44	342	
1944–45	988	abundant
1945–46	1309	scarce
1946–47	839	scarce
1947–48	503	increase
1948–49	570	increase
1949–50	531	abundant
1950–51	857	increase
1951–52	1347	increase
1952–53	350	very abundant
1953–54	536	scarce

[1]. Published by permission of the Fur Trade Department, Hudson's Bay Company.

The periodicity of the maxima and minima in the data for fox numbers is shown in Table 2. The value of 318 for 1921–22 (Table 1) cannot be compared with data from the previous year, and has not been included. Authors disagree as to how peaks should be chosen, but the figure of 570 for the 1948–49 season (Table 1) has not been treated as a peak, on the grounds argued by Butler (1953). Thus the values shown in Table 2 give a mean periodicity of 4.0 years for the maxima and minima, conforming to the usual periodicity assigned to this species in this part of its range (Chitty, 1950,

Table 2. Periodicity in the maxima and minima of fur returns for arctic fox in the Pond Inlet area from 1921–22 to 1953–54.

Maxima	*Interval*	*Minima*	*Interval*
1923–24		1924–25	
1926–27	3 years	1928–29	4 years
1930–31	4	1932–33	4
1934–35	4	1936–37	4
1937–38	3	1939–40	3
1942–43	5	1943–44	4
1945–46	3	1947–48	4
1950–51	5	1951–52	4
Total	27		27
Mean	4.0		4.0

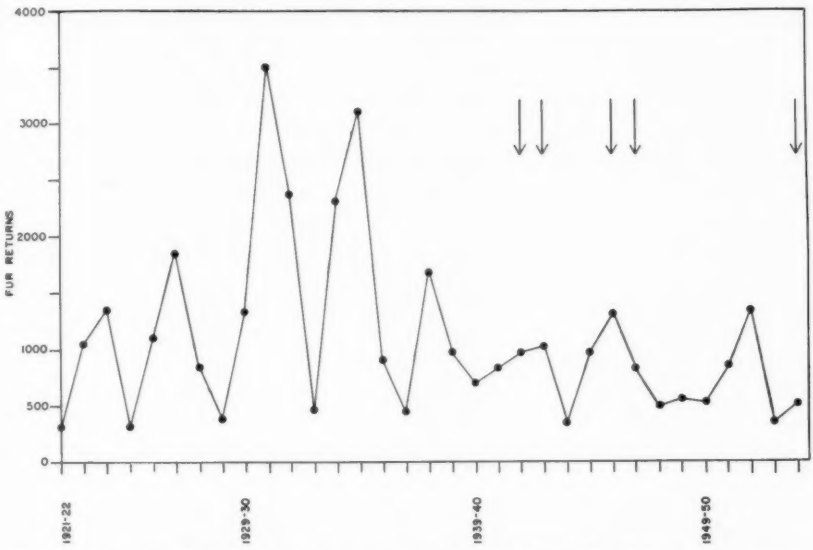

Fig. 3. Hudson's Bay Company fur returns for arctic fox at Pond Inlet from 1921–22 to 1953–54. Seasons of lemming scarcity are indicated by arrows.

pp. 182–3; Butler, 1953, pp. 246–7). It should be noted that the periods of relative abundance and scarcity of each of the "cyclical species" on Bylot Island correspond with those on Baffin Island.

Canis lupus. Gray Wolf. *Amarok.*

Wolves have not been seen on Bylot Island since the elimination of the caribou herd in 1943.

Phoca hispida. Ringed Seal. *Netchek.*

This is the common seal in the waters around Bylot Island and throughout this part of the eastern Arctic, and it is the principal animal in the economy of Eskimo. There is no reliable way of estimating its numbers or how many the Eskimo kill. Idlouk, who keeps an account of his game kill, says that his yearly kill is between 200 and 300; Idlouk is an exceptional hunter, but he also supplements his diet with other animals. If Idlouk's average were extended to the other hunters, it would mean an annual total kill of about 11,250 seals.

The stomachs of 8 seals taken in Eclipse Sound and Pond Inlet contained a large species of gammarid, which the Eskimo claim is the principal prey of the ringed seal, young and adults alike. During the spring and summer the seals do not seem to eat many fish, even though arctic char (*Salvelinus alpinus*) are abundant. On several occasions seals were seen among the ice floes offshore from the Salmon River near Pond Inlet, where char gathered during

their migration, but the seals did not move inshore to feed on the fish nor did the stomachs of seals taken in this area contain fish.

Phoca groenlandica. Harp Seal. *Kyrolik.*

The harp or saddleback seal is found in Pond Inlet and Navy Board Inlet at the end of July or early in August, during an annual migration into Tay Sound, south of Eclipse Sound. These seals are quite numerous at Guys Bight

Table 3. Arrival date of bearded seal and narwhal in Eclipse Sound, compared with date of ice break-up, yearly since 1946.

Year	*Arrival of narwhal and bearded seal*	*Date of Ice break-up*
1946	30 July	11 August
1947	26 July	7 August
1948	1 August	28 July
1949	26 July	27 July
1950	25 July	23 July
1951	21 July	17 July
1952	25 July	4 August
1953	23 July	4 August
1954	18 July	7 August[1]

[1]. Date estimated by Idlouk, on basis of ice conditions up to July 31.

and in the northernmost waters of Navy Board Inlet, both close to their normal migration route in Baffin Bay; fairly large numbers enter Eclipse Sound from Navy Board Inlet and Pond Inlet and pass into Tay Sound along the same migration path followed by narwhal. They stay in Tay Sound until about September 25 and move out again into the open sea as ice begins to form.

Erignathus barbatus. Bearded Seal. *Oogjuk.*

The Eskimo report that bearded seals sometimes winter in Eclipse Sound and Pond Inlet, but they are usually seen only in summer. Since these animals are rather solitary and prefer open water, they are never very abundant in this area.

Bearded seals invariably enter the inland waters on the same day as narwhal. Table 3 shows the annual arrival of bearded seal and narwhal compared with the dates of ice break-up in these waters. These records are from the annual log kept by Idlouk, who defines the ice break-up as the first day a boat can safely cross Eclipse Sound. When the expedition left Bylot Island on July 31, Idlouk correctly estimated that it would be another week before the ice on Eclipse Sound would be open.

The two species are seen as much as twelve days before the ice breaks up, but show only eleven days range in their dates of arrival over the period for which data are available, as compared with a range of twenty-five days in the dates of ice break-up. Since the ice sometimes remains in the sounds until the second week of August and begins to reform about the middle of September, the migratory movements of mammals that prefer open water are restricted to a short period in this area. The bearded seal and narwhal are, however, able to use limited spaces of open water and can move into the sounds and inlets before they are free of ice.

Cystophora cristata. Hooded Seal. *Apa.*

A few hooded seals occasionally enter Pond Inlet and Eclipse Sound in the summer with harp seals; no more than 3 have ever been seen in a year. The Eskimo are, however, familiar with the hooded seal and recognize it readily by its habit of swimming low in the water with only the top of the head exposed and by the inflatable sac on the nose of the males.

Odobenus rosmarus. Walrus. *Ivik.*

One of the northernmost breeding grounds of the walrus is the Wollaston Islands, off the northwest tip of Bylot Island, but walrus are reportedly abundant all through Lancaster Sound. The Pond Inlet Eskimo generally hunt them along the floe edge of Pond Inlet and the total kill is only about 10 each year. A few of the Eskimo have made boat trips to the Wollaston Islands to hunt; their reports of the population size vary considerably and are probably not reliable. The most conservative estimate places the breeding population between 200 and 300 adults.

Lemus trimucronatus. Brown Lemming. *Avignak, Kayook.*

No brown lemmings were found by the expedition, either on Bylot Island or Baffin Island, although both are within its range of distribution (Miller and Kellogg, 1955, p. 566). The Eskimo say that the brown lemming is found on the island, but is not as common as the Greenland collared lemming. They readily identified both the brown and Greenland collared lemmings from illustrations, and though the word *avignak* is used for any lemming, they have different names for the two species.

Dicrostonyx groenlandicus. Greenland Collared Lemming.
Avignak, Amiglak.

The summer of 1954 was a period of lemming scarcity, following a peak in 1953, and only 4 *Dicrostonyx* were taken; one of these was from a strictly natural habitat on Bylot Island, the other 3 were living under the buildings of the Hudson's Bay Company at Pond Inlet.

This species reportedly reaches high densities in the southwest lowlands, where favourable habitat is most extensive. A particularly intensive search for lemmings and snowy owls was made in the vicinity of Ooyarashukjooeet, where they had been most abundant in 1953. Except for sand or gravel areas where vegetation was sparse, it was impossible to walk across the tundra slopes without stepping on lemming runs or burrows, yet trapping was fruitless and all evidence of lemming activity proved to be from previous years. Only one snowy owl was seen and very few of a large sample of owl pellets were fresh.

The vegetation in this area was examined closely for evidence of heavy browsing or damage to food plants by lemmings. The stems of some of the older willows had been barked, but not extensively, and there was nothing to indicate that food or habitat conditions were unfavourable. If, as some authors

maintain (Lack, 1954, pp. 214–6, 223, 226), food is a primary factor in lemming "crashes", the effect on the flora should be apparent in the years following peak numbers. The Eskimo report that *Salix arctica* is the principal food plant of the lemmings, although they will also eat most of the other herbs and grasses; captive lemmings ate the young leaves of all willow species and the stems and leaves of *Carex misandra* and seemed to stay healthy. These plants were abundant everywhere in the tundra.

None of the Eskimo had seen a lemming migration, and such a thing is not recorded in their folk tales. They have seen lemmings on ice floes at the water's edge during periods of high numbers, but never more than a few at a time.

Lepus arcticus. Arctic Hare. *Okalek.*

A few arctic hares are found on the lowlands of Bylot Island. They are never as abundant on Bylot Island as they are near Pond Inlet, but periodic fluctuations in numbers are apparently synchronous in the two populations. This was learned from the Arctic Wildlife Enquiry reports and from statements by the natives.

Rangifer arcticus. Barren Ground Caribou. *Tuktoo.*

For some years caribou were known to be on the northeast coast of Bylot Island. The only route to this area is along the east coast where the ice is often impassable during winter, and the caribou were, therefore, beyond the reach of native hunters. In 1941, however, for the first time in several years, a party of Eskimo was able to negotiate the ice along the coast and found a fairly large herd on the lowlands near Cape Liverpool. They killed 149 deer. In 1942 another caribou hunt was organized; the herd was found between Bathurst and Possession bays and 24 caribou were shot. In 1943 a hunting party journeyed to the north coast and killed 300 caribou in the area between Maud Bight and Cape Liverpool. Few if any survived this last onslaught, and subsequent attempts to find caribou on the island have been unsuccessful.

The Tununermiut are coastal people and rarely venture more than a few miles inland, so that if the caribou could move to an inland area they would probably not be molested. Bylot Island does not afford such a refuge, and since there are very few areas that can support caribou, it is therefore improbable that this species will ever survive on Bylot Island unless completely protected.

Balaena mysticetus. Bowhead Whale. *Akbilk.*

Following Parry's voyage to Possession Bay in 1819, the waters off the east coast of Bylot Island became one of the most famous of the northern whaling grounds and the floe edge at Button Point was visited frequently by whalers during the next half century. Now, seldom more than a few whales are seen each year off Button Point and only occasionally do they enter Pond Inlet and Navy Board Inlet.

Whale skeletons are fairly numerous along the beaches of Pond Inlet, Eclipse Sound and Navy Board Inlet, and are sometimes found on raised beaches as much as two miles inland and 200 feet above the present shore. The Eskimo have no stories to account for these skeletons. The identification of this species was made by W. Schevill (personal communication) from photographs of skulls found along the beaches.

Grampus orca. Atlantic Killer Whale. *Ahgluk.*

At least 10 to 20 killer whales are seen in Eclipse Sound and Pond Inlet every August, apparently following the migratory mammals already discussed and preying on the ringed seals. The whales, in packs, drive the seals inshore where they are easy game for the Eskimo.

Delphinapterus leucas. White Whale. *Kaudlookta.*

This species is fairly common in Lancaster Sound where about 100 to 200 are seen in June and July each year at the floe edge of Pond Inlet. Sometimes 10 or 15 are seen in the inland waters of Eclipse Sound, usually in August, but this is not a regular occurrence.

Monodon monoceros. Narwhal. *Kilaluga.*

During late July narwhal enter Navy Board Inlet from Lancaster Sound, and Pond Inlet from Baffin Bay; they generally follow two migration paths that converge in Eclipse Sound off the southwest tip of Bylot Island. Between 500 and 1,000 are seen along the southern coast of the island every year, travelling in groups of as many as 200. From Eclipse Sound they move south into Tay Sound where they stay until ice begins to form in September. As mentioned earlier, the arrival of this species invariably coincides with that of the bearded seal.

The first narwhal seen on this expedition were in an area of open water at the mouth of the Aktineq River on the morning of July 18. Their progress could be followed from some distance, by the sound of their blowing when they surfaced. Several were located in this manner and observed from the ice at close range as they passed along the leads. Of the 22 narwhal seen between July 18 and 30, only 4 had tusks sufficiently prominent to identify them as males.

The Eskimo had reported that narwhal often surface in seal holes, which are enlarged late in the season by the runoff of melt water from the surface of the ice. Since the largest of these holes is seldom more than fifteen or twenty feet in diameter, this seemed somewhat improbable; however, 4 females were watched for about ten minutes as they surfaced, one or two at a time, in a single seal hole which was not more than eighteen or twenty feet across. They seemed to maintain a steady rhythm of rising, heads pointed upwards, then sliding back beneath the surface, and continued to surface in this fashion until we had crept to within about twenty feet of them.

Whales with two tusks are sometimes seen. Idlouk has a photograph of a narwhal killed in Tay Sound in 1953, with one tusk four feet long and

the other three feet long. The Pond Inlet Eskimo think that the narwhal tusks are used in fighting, but can give no real evidence to support this hypothesis.

I wish to thank the Hudson's Bay Company for permission to publish the fur returns shown in Table 1. I am also grateful to Peter Murdoch of the Hudson's Bay Company and Constable Moody, of the Royal Canadian Mounted Police, for help and advice during this study, and especially to Eskimo Idlouk, whose companionship and contributions were invaluable.

References

Burt, W. H. and R. P. Grossenheider. 1952. 'A field guide to the mammals'. Boston: xii + 200 pp.

Butler, L. 1953. "The nature of cycles in populations of Canadian mammals". *Can. J. Zool.* Vol. 313, pp. 242–62.

Chitty, Helen. 1950. "Canadian Arctic wildlife enquiry, 1943–49: with a summary of results since 1933". *J. Anim. Ecol.* Vol. 19, pp. 180–93.

Drury, W. H. 1954. "The 1954 Bylot Island Expedition". Unpublished MS.

Lack, D. 1954. 'The natural regulation of animal numbers'. Oxford: viii + 343 pp.

Miller, G. S., Jr. and R. Kellogg. 1955. 'List of North American recent mammals'. *U.S. Nat. Mus. Bull.* No. 205, xii + 954 pp.

MICRORELIEF PRODUCED BY SEA ICE GROUNDING IN THE CHUKCHI SEA NEAR BARROW, ALASKA*

Robert W. Rex†

IT HAS long been known that sea ice and glacial icebergs ground in shallow water (Transehe, 1928, p. 102) and can deform the bottom (H.O. 77, 1951, p. 31; United States Coast Pilot, 1947, p. 594). Small-scale microrelief has been noted on the inner shelf of the Beaufort Sea off the Colville River by Carsola (1952, pp. 22, 64; 1954, p. 159) who suggested that it is caused by ice grounding. Pressure ridge ice is often the last fast ice to break up and float free in the summer. Frequently the inner fast ice in water of 20 to 30 feet depth will break up while pressure ridge ice remains grounded in deeper water. Boat observations at the time of break-up are extremely hazardous and little accurate information is available as to the depths of ice groundings. In the summer of 1954 the writer studied the microrelief off Barrow, Alaska, to determine the effective range of grounding of the polar pack ice.[1] The Barrow area of the Chukchi Sea was chosen because it is the northernmost shoal area of Alaskan waters and the site of the Arctic Research Laboratory.

Method

Numerous short echo sounding traverses were carried out in a boat to establish confidence in the instruments, procedures, and the reality of the microrelief, then 6 bathymetric traverses were made, all together consisting of 14 legs. These traverses and a summary of the results obtained are shown in Fig. 1. The microrelief studied here is not the same as that described by Carsola (1954) for deeper waters of the outer continental shelf to the northwest of the Barrow area.

Depth determinations were made with a new Bludworth Model NK-6 echo sounding recorder operating at 14.25 kilocycles, for which the power supply was 12 volts from the boat's batteries. The echo sounder was the only power drain on the batteries during the period of its operation. Frequent checks from a moored boat showed that no measurable changes in depth were recorded by the instrument at any engine or generator speed encountered

*Contribution from Scripps Institution of Oceanography, New Series No. 845.

†Scripps Institution of Oceanography, La Jolla, California.

[1]This study was aided by a contract between the U.S. Office of Naval Research and the Arctic Institute of North America. Reproduction in whole or in part is permitted for any purpose of the United States government.

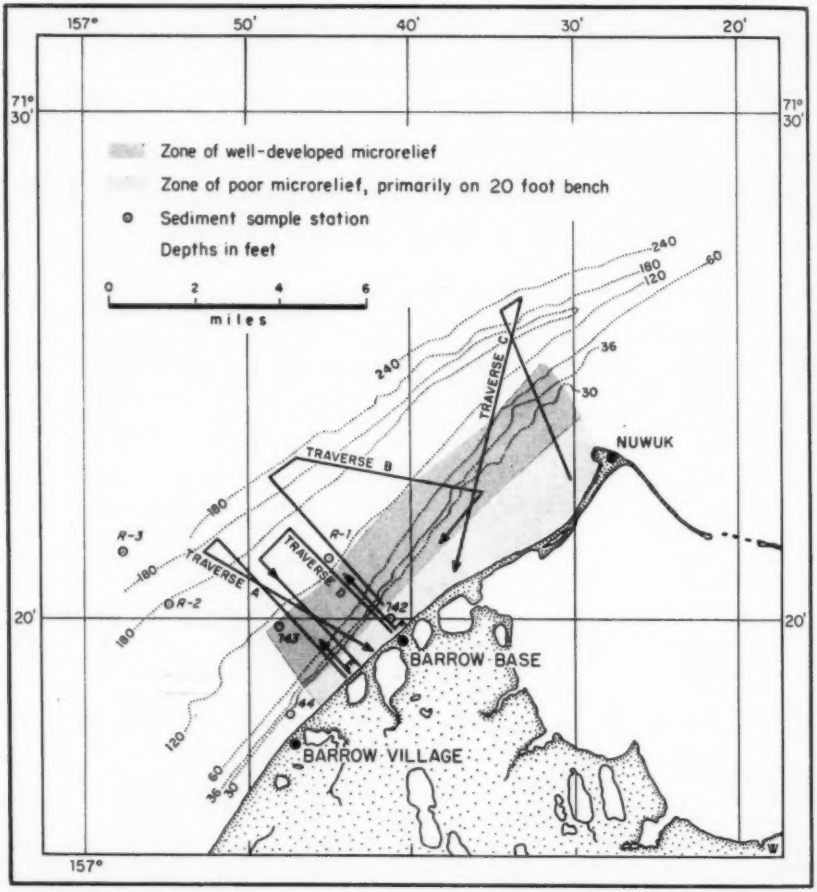

Fig. 1. Barrow area, showing zone of sea ice grounding and location of echo sounding traverses A–F.

during the traverses. In addition, depth checks were made with a hand line. Therefore the depth fluctuations recorded are assumed real for values $\pm \frac{1}{2}$ foot.

Sediment samples R-1, R-2, and R-3 (Fig. 1) were obtained with a Dietz-LaFond snapper and samples 142 and 143 with a 1⅜ inch I.D. gravity corer.

Results

The traverses generally showed irregular depth fluctuations of 8 feet or less over distances of 25 to 50 feet, superimposed on a very gently sloping bottom. These depth variations occur both parallel (Fig. 2) and perpendicular (Fig. 3) to the depth contours. Figure 2 was made at a speed of ¼ knot drifting with the current parallel to the depth contours. Depth fluctuations

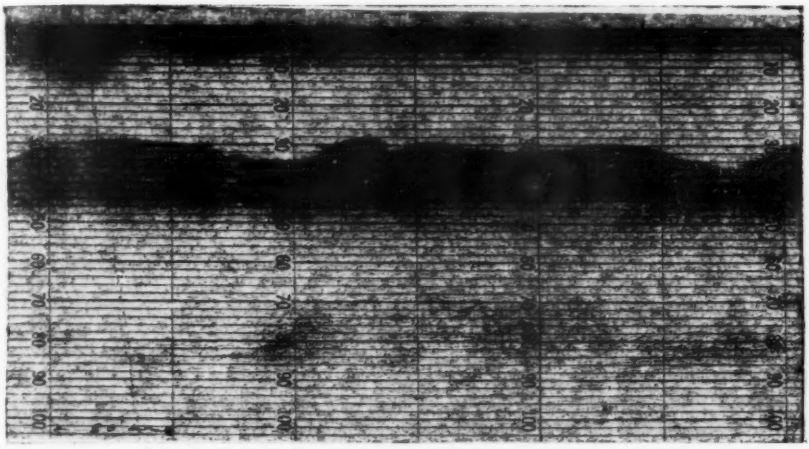

Fig. 2. Echo sounding traces, parallel to contours near Traverse F. Depth in feet. Add 2 feet to depths for transducer depth correction. Distance between vertical lines approximately 25 feet.

were determined simultaneously with the echo sounder and a hand line and agreement was ± ½ foot.

Microrelief is best developed between depths of 20 and 80 feet, where it is often 6 feet, and in one case reached 12 feet (Fig. 3). Moderate microrelief usually extends to a depth of 100 feet (Fig. 4).

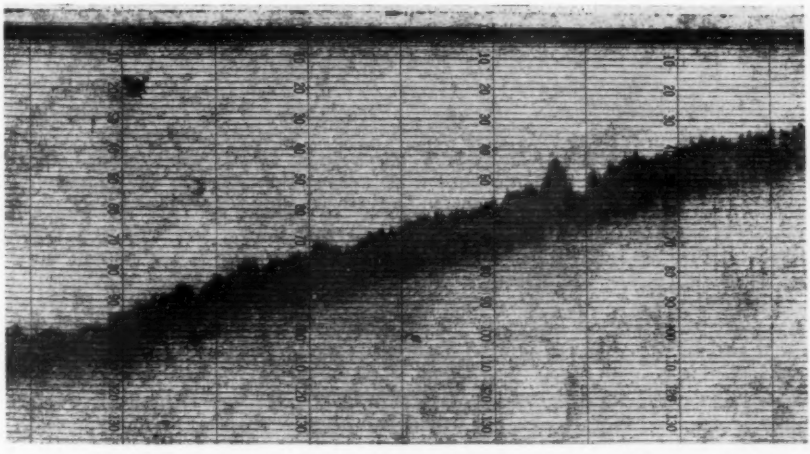

Fig. 3. Slope from 35 to 100 feet showing development of microrelief perpendicular to contours. Depth in feet. Add 2 feet to depths for transducer depth correction. Distance between vertical lines approximately 200 feet.

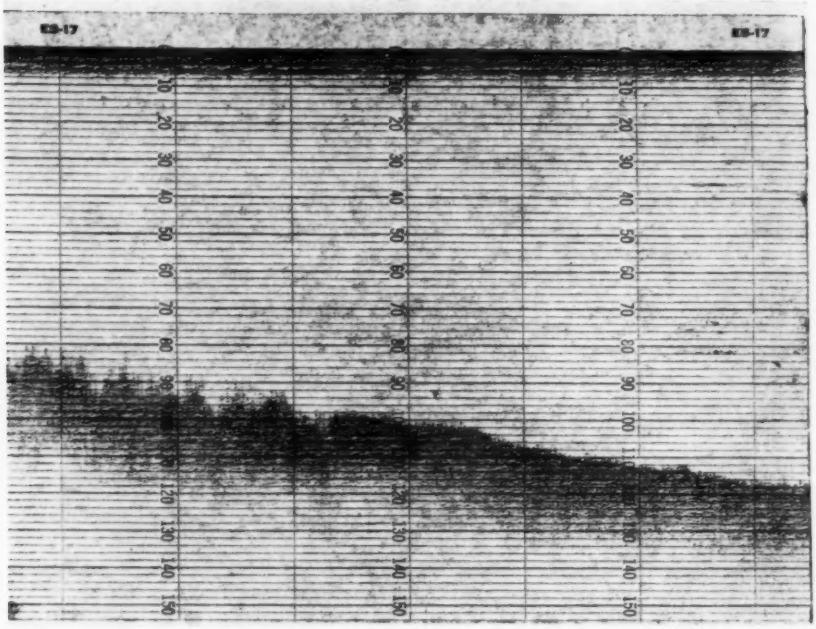

Fig. 4. Traverse D, leg 1, from 80 to 120 feet, showing the transition from microrelief above 100 feet to microrelief-free slope below. Depth in feet. Add 2 feet to depths for transducer depth correction. Distance between vertical lines approximately 80 feet.

A submerged shoreline marked by drowned river and stream valleys and a broad bench from 20 to 30 feet in depth (Fig. 5) characterizes the northern Alaska coast of the Chukchi Sea. Pack ice impinges against the outer portion of this 20-foot bench or terrace in the Barrow area and forms pressure ridges. Brash ice,[1] some pack ice, and young pancake ice fill the area above the 20-foot bench. The ice is grounded in places and remains as part of the fast ice in the spring. Moderate microrelief is developed on the 20-foot bench (Fig. 6) and pressure ridge ice extends seaward from it. Aerial photographs indicate that the main series of contiguous pressure ridges occur in water depths between 20 and 100 feet, coinciding almost exactly with the depth distribution of the microrelief. Pressure ridges also occur in various patterns in the open pack, but not as a continuous zone of crumpled ice over a mile in width and hundreds of miles in length, as is true of the fast pressure ridge ice. Fast pressure ridges have in general an arcuate pattern with overall lineation very roughly parallel to the depth contours. Pressure ridge ice forms the

[1]All sea ice terminology is in accord with the definitions given in the U.S. Hydrographic Office sailing directions for arctic waters, for example H.O. 77, 1951.

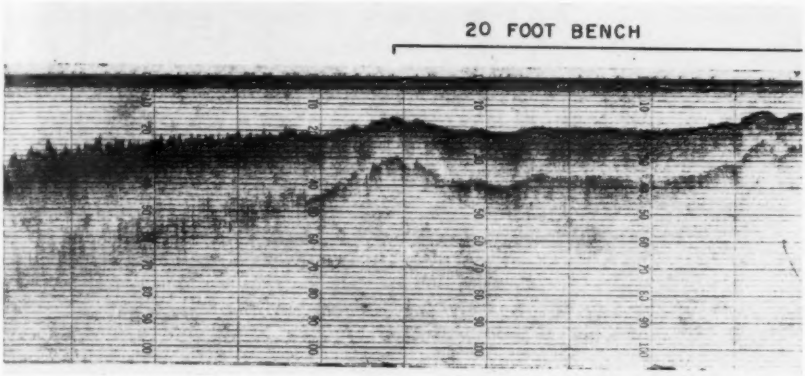

Fig. 5. Traverse from near shore bar (right), across 20-foot bench to ridge where inner pressure ridge ice grounds, downslope to 30 feet in the zone of microrelief (left), in the vicinity of Traverse F. Note relative absence of microrelief from 20-foot bench. Depth in feet. Add 2 feet to depths for transducer depth correction. Distance between the vertical lines approximately 200 feet.

principal body of fast ice in spring and early summer, sometimes containing large quantities of silt and fine sand, and occasionally it contains some mollusc shells.

Before accepting the hypothesis of pack ice grounding to explain the microrelief a number of alternate hypotheses were considered. These were: residual features of thawed permafrost, slump topography, current scouring, and sand waves.

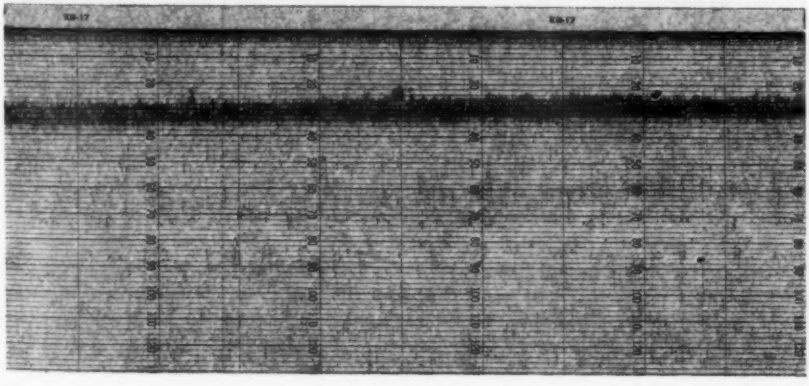

Fig. 6. Traverse C, leg 2, microrelief developed on the 20 to 30-foot bench in a level area. Depth in feet. Add 2 feet to depths for transducer depth correction. Distance between vertical lines approximately 150 feet.

Thawed permafrost as described by Hopkins in the Imuruk Lake area of the Seward Peninsula (1949) may be an explanation for some of the microrelief found in the Chukchi Sea. The thaw lakes in the Imuruk Lake area are up to several hundred feet in width and 30 feet in depth. Carsola (1954, p. 1598) suggests that possibly the microrelief observed to the northwest of the Barrow Sea Valley resulted from the thawing of Pleistocene permafrost by a rising sea. Relict thawed permafrost topography is readily buried under prograding continental shelf sediments and can be expected only in areas free of sedimentation from the time of their submergence to the present day. The East Chukchi Sea-Alaska Coastal Current carries sediments northward on and near the bottom of the shelf to the north-northeast trending Barrow Sea Valley. It therefore appears probable that Carsola's area of microrelief, to the northwest of the Barrow Sea Valley, lies in a sediment "shadow" thereby meeting the requirement of non-deposition of sediments for the present day preservation of thawed permafrost topography.

The microrelief studied in the Barrow area by the writer differs in a number of important ways from the microrelief studied by Carsola. The Barrow microrelief is of smaller dimensions; the relief is 6 feet compared to a maximum of 30 feet, and 100 feet in length compared to a maximum of 1,000 feet. It lies on the southwest side of the Barrow Sea Valley, between the valley and the present shore line, within a zone of sedimentation; and it occurs at depths between 20 feet and 100 feet, whereas Carsola's microrelief occurs at about 300 feet.

The sediments on shore consist of 150 to 200 feet of Recent and possibly Pleistocene unconsolidated silts, sands, and gravels of the Gubik formation (Payne, 1951; Gryc and others, 1951). A stratigraphic study (Rex, 1953) indicated that the upper portion of the Gubik formation in this area consists of prograding marine sands and silts overlain with littoral deposits of beach sands and gravels. A series of uplifted beach ridges (Rex, 1953) extends inland from the Barrow area. Black (1952) estimated from the growth rate of ice wedges that the age of the uplifted beach deposits near the coast is approximately 3,500 years, supporting the concept of recent sedimentation in this area at a time when sea level was within 10 to 20 feet of its present stand. Sediments forming the beach and shallow water deposits can certainly be expected to mask any residual permafrost topography in some cases less than 1,000 feet away and in water only 20 feet deep. Extensive movement of silt occurs in this area during summer storms when the water is extremely turbid. Therefore thawed permafrost is rejected as an explanation of the microrelief observed by the writer.

Slump topography described by Shepard (1948, pp. 195–8; 1955, p. 1479) is characterized by irregular undulating or hummocky relief and slump scars or valleys in the source areas. The presence of microrelief on the broad and flat 20-foot bench cannot be explained as slump topography, because slumps must have a source and slump scars are not evident in association with the microrelief on the 20-foot bench. Gravity cores, Samples 142 and 143 (Fig. 1), taken in the area of microrelief disclose a compact grey silt beneath 2 to 5 feet

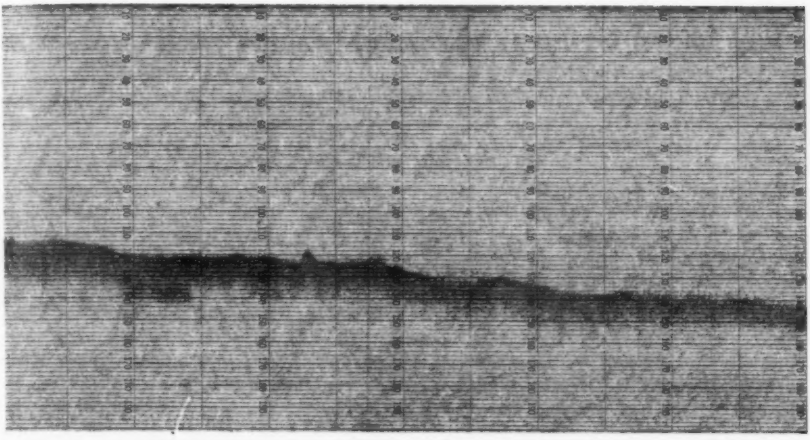

Fig. 7. Traverse B, leg 1, gently undulating relief, more like slump topography than is the shallower microrelief attributed to sea ice grounding. Depth in feet. Add 2 feet for transducer depth correction. Distance between vertical lines approximately 80 feet. Compare with Fig. 4 for scale of microrelief.

of soft grey silt. The compact sediment contains a fine structure that is usually destroyed in slump material. In addition, the extreme sharpness of the microrelief is not characteristic of slump terrain. Handline soundings show this sharpness better than do echo soundings which tend to smooth bottom irregularities. It is possible that some of the deep undulating relief below 120 feet may be slump topography (Fig. 7), but this deeper topography differs from the shallower microrelief in being of greater width and lesser relief, suggesting that a slump origin is an unsatisfactory explanation for the shallow microrelief.

Current scouring occurs in the Barrow area. Deep scour channels result where large quantities of water pass through the inlet between Elson Lagoon and the open sea at speeds sometimes exceeding four knots. The East Chukchi Sea-Alaska Coastal Current flows to the northeast over the microrelief area with an average speed of one knot and occasionally attains two to three knots with a favourable wind. This current is sometimes reversed temporarily by strong winds from the northeast and then flows to the southwest. In midsummer after ice break-up and before the first summer storm, the waters of the Chukchi Sea at Barrow are unusually clear permitting white objects on the bottom to be observed at depths of 50 feet. It was evident that no bottom veil or cloud of sediment was being moved across the 20-foot bench at times when the current flow was two knots. Microrelief disappears relatively abruptly below a depth of 100 feet. To create microrelief by current scouring a two-layer water mass is necessary, with fast moving water above 100 feet and slow moving water below. Temperature, salinity, and paravane current data do not support the presence of a two-layered system with an interface at 100 feet depth. On the contrary, the data indicate nearly isothermal water

with irregularly varying salinity related to sea ice melt water and river runoff. Traverse E, made after a strong storm late in the summer, lies about 300 feet to the northeast and parallel to Traverse A (Fig. 1). The effect of the storm was very slightly noticeable in Traverse E and tended to diminish the microrelief on the 20-foot bench, not increase it. These observations effectively eliminate the possibility of current scour as a mechanism of microrelief formation.

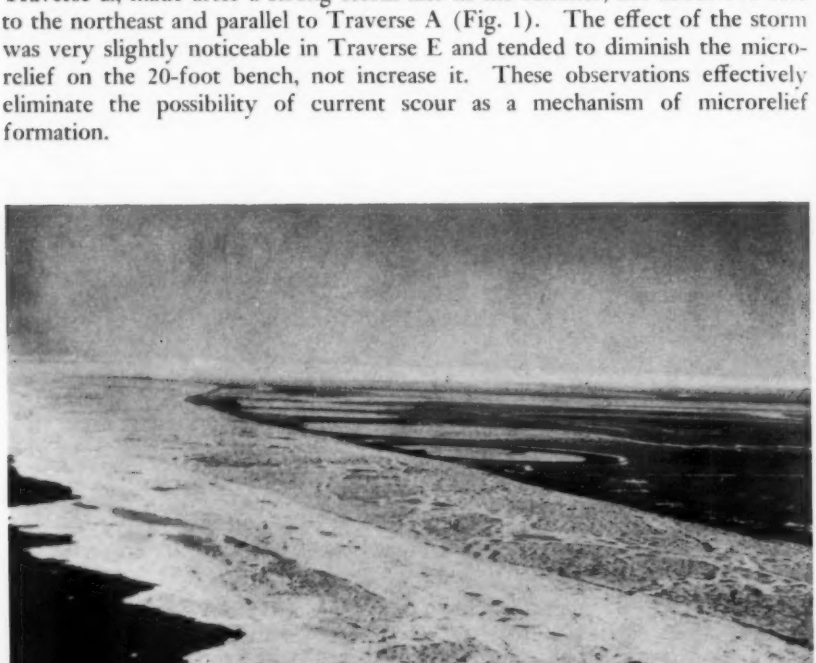

Fig. 8. Fast ice near Barrow, looking northeast from 1,500 feet, 28 June 1952. The dark puddled area near the shore (right) overlies the 20-foot bench. Two weeks later the fast ice broke up and floated free.

Sand waves cannot explain the microrelief because it is developed in an area of predominantly silt sediments and shows no symmetry, a characteristic feature of any ripple mark.

Pack ice grounding could cause the development of microrelief in a way that explains all the observed features. Fast pressure ridge ice, as indicated by aerial photographs (Fig. 8), is restricted almost completely to the zone of microrelief. The pressure ridge ice, as previously noted, sometimes contains large quantities of silt and occasionally shells. This supports the hypothesis of contact with the bottom. The sharpness of the microrelief and the scale are what one would expect if an average ice floe (4–6 feet thick and 20–100 feet in diameter) were up-ended by the pressure of other floes and driven into the bottom. The abrupt end of microrelief at 100 feet can be explained as the maximum depth at which pack ice grounds. Perhaps the relatively

uniform value of this deeper limit represents a depth where a balance occurs between the buoyant force of the water on the pressure ridge ice and the load of ice floe telescoped upon ice floe by the maximum force of the polar ice pack in the Barrow area.

In 1952 the writer observed that the pressure ridge ice seaward of the 20-foot bench remained grounded for a period of more than twelve hours after the break-up of the ice over the 20-foot bench. In view of the constant coastal current in excess of one knot this observation is taken as proof that at least some pack ice grounds seaward of the 20-foot bench. The indirect and direct evidence are therefore considered to support the hypothesis of sea ice grounding to a depth of 100 feet to the exclusion of other hypotheses.

The probability of sea ice grounding as a function of time was not determined. It is suggested that, on the basis of the sharpness of the microrelief, grounding is most frequent between 20 and 80 feet. Grounding below this depth is probably less frequent and occurs with less bottom gouging than grounding within this depth range.

Ice grounding serves to mix the surface sediments, perhaps to a depth of 4 to 5 feet thereby destroying stratification, oxygenating the sediment, and considerably modifying the environment of benthonic organisms.

Aerial photographs of a coastal area taken in spring and early summer indicate the belt of pressure ridge ice and therefore the zone of ice grounding (Fig. 8). For increased accuracy photographs covering a period of several years should be used.

Subsequent to the completion of this paper MacGinitie (1955) has made a number of comments on sea ice grounding. His observations agree with those of this writer, but are of a more general nature. MacGinitie's winter observations are of special interest; he notes that the pack "ice grounds offshore where the water is 60 to more than 100 feet deep and forms what is spoken of as the 'big pressure ridge'" (p. 12). This major pressure ridge forms nine years out of ten and "from shore to a depth of over 100 feet offshore the bottom is rubbed and gouged by ice" (p. 14). Later he again mentions that "ice grounds out to a depth of 90 to 100 feet" inhibiting faunal development (p. 53) and that grounding ice may have rubbed organisms off large stones and boulders found in a rubble zone (p. 62).

The author wishes to express his appreciation for the assistance of the Director, Mr. T. Mathews, and Staff of the Arctic Research Laboratory; Dr. W. K. Lyon and Staff of the U.S. Navy Electronics Laboratory, and the considerable help both at sea and ashore of Dr. M. Schalk and Mrs. J. R. Rex. The author is indebted to H. L. Burstyn for his comments on the manuscript.

References

Black, R. F. 1952. "Growth of ice-wedge polygons in permafrost near Barrow, Alaska". (Abstract of paper presented at the November meeting of the Geological Society). *Geol. Soc. Amer. Bull.* Vol. 63, pp. 1235–6.

Carsola, A. J. 1952. 'Marine geology of the Arctic Ocean and Adjacent Seas off Alaska and Northwestern Canada'. University of California at Los Angeles, unpublished Ph.D. thesis.

1954. "Microrelief on the arctic sea floor". *Amer. Assoc. Pet. Geol. Bull.* Vol. 38, No. 7, pp. 1587–1601.

Gryc, G., W. W. Patton, Jr., and T. G. Payne. 1951. "Present Cretaceous stratigraphic nomenclature of northern Alaska". *J. Wash. Acad. Sci.* Vol. 41, pp. 159–67.

Hopkins, D. M. 1949. "Thaw lakes and thaw sinks in the Imuruk Lake area, Seward Peninsula, Alaska". *J. Geol.* Vol. 57, pp. 119–31.

MacGinitie, G. E. 1955. "Distribution and ecology of the marine invertebrates of Point Barrow, Alaska". *Smithsonian Misc. Coll.* Vol. 128, No. 9, Pub. 4221, iv + 201 pp.

Payne, T. G. 1951. "Geology of the Arctic Slope of Alaska". *U.S. Geol. Surv. Oil and Gas Invest.* Map OM 126 (in 3 sheets).

Rex, R. W. 1953. 'Uplifted-beach ridges and first generation lakes in the Barrow, Alaska area'. U.S. Office of Naval Research Final Report, Section 2, Contract Nonr 225 (09), Unpublished.

Shepard, F. P. 1948. 'Submarine Geology'. New York: xvi + 338 pp.

1955. "Delta-front valleys bordering Mississippi distributaries". *Geol. Soc. Amer. Bull.* Vol. 66, No. 12, Part 1, pp. 1489–1498.

Transehe, N. A. 1928. "Ice cover of the Arctic Sea, with a genetic classification of sea cover" *in* 'Problems of polar research'. *Amer. Geogr. Soc. Spec. Pub.* No. 7, pp. 91–123.

United States Coast Pilot. 1947. 'Alaska. Part 2. Yakutat Bay to Arctic Ocean'. 5th ed. Washington, D.C.: xi + 659 pp. (U.S. Coast and Geodetic Survey. Ser. No. 680).

U.S. Hydrographic Office. 1951. 'Sailing directions for northern Canada . . .'. 2nd ed. Washington, D.C.: xxvi + 582 pp. (H.O. Pub. No. 77).

REVIEWS

HIGH TIDE AND AN EAST WIND. THE STORY OF THE BLACK DUCK.

By Bruce S. Wright. *Harrisburg, Pa.: The Stackpole Co., and Washington, D.C.: The Wildlife Management Institute. 1954. 9 x 6 inches; xiii + 162 pages; illustrations; maps. $4.50.*

'High tide and an east wind' contains the results of a study of the Black Duck "to find out what, if anything, could be done to improve breeding conditions" in that part of the species' flyway lying in eastern Canada. Work was begun in 1945 and pursued in the St. John River valley in New Brunswick, and also, less intensively, in Labrador and Ungava. Data from all parts of the Black Ducks' range are presented and topics include: spring migration, reproductive behaviour, survival of young, food habits, autumn migration, hunting, distribution, and management. The treatment is mainly in seasonal order.

Readers of *Arctic* will be interested to see frequent references to conditions in Labrador and Ungava, based on Wright's travels in southern Labrador in June 1947, and in Ungava in August and September 1948. 'Report on explorations in the Labrador Peninsula . . .' by A. P. Low, 1896, is quoted extensively. Through an oversight, perhaps, there is no reference to the extensive aerial surveys of waterfowl carried out annually in Ungava since 1952 by the United States Fish and Wildlife Service.

'High tide and an east wind' contains more information on the Black Duck than has appeared elsewhere, and few will read it without increasing their knowledge. This book shows a pleasing regard for the aesthetic attributes of the birds and the country they frequent; the vocabulary employed is such that persons without an ornithological background need not hesitate to read it. However, many readers will find the style ambiguous and may feel that, for a scientific account, there is undue intrusion of personal references. The scientist will note (and the laymen should be warned) that a number of conclusions are categorically stated on the basis of rather scanty evidence. For example, no evidence is given that great horned owls have taken a serious toll of a local population of waterfowl (p. 27). Similarly on page 49, the protozoan blood parasite, *Leucocytozoon anatis*, is called "The most serious cause of duckling mortality from disease and parasites among Black Ducks". This may be so, but it should be demonstrated. It is stated that infection by different life stages of *Leucocytozoon* was noted in at least 6 out of 19 Black Ducks (or 9 out of the 19, the statement is not clear) yet, contrarily, on page 51 it is concluded that, because no sick ducks were found, the parasite "is not a serious mortality factor in this region". The reviewer is puzzled also by the following sentence: "The Ontario flights bound for the south Atlantic States are from two to three weeks earlier than those from the northeast, and they reach the lower Mississippi and the Gulf Coast in the latter part of December". Either the phrase "south Atlantic States" is incorrectly applied or it must be assumed that the Mississippi migration route includes a swing toward the Carolinas and Georgia.

Because the average brood of Black Ducks less than two weeks old is 8, and the average number of eggs in completed clutches is 9, it is deduced that "infertile eggs may be responsible for a loss of one egg, or 11 per cent of the clutch" (p. 47). Such a high rate of infertility is not uncommon among domestic waterfowl, but is rare in the

wild. Failure of young to hatch because of malposition of the fully-developed embryo or abnormal hardness of the shell, and losses due to accidents or unfavourable weather during the first day or two after hatching might be expected to account for a significant proportion of the 11 per cent attributed wholly to infertility.

The relation of forest fires to Black Duck reproduction is mentioned briefly (p. 40) and it is stated that 12.1 per cent of the total acreage burned in New Brunswick is burned during the nesting season. It would be more useful had the writer presented the actual rather than the relative extent of burning in the spring, and then estimated the effect of fire on Black Duck populations.

Figures depicting distribution and migration of Black Ducks may mislead those who do not read the text carefully. For instance, the post-breeding range of the species is indicated to include all of Saskatchewan and at least one-third of Alberta, as well as adjoining portions of the Northwest Territories. Several isolated records are the only basis for the range as shown, and the area mentioned cannot be considered within the species' normal range.

Illustrations, both photographs and drawings, the latter by Peter Ward, are generally excellent and in spite of the shortcomings mentioned, everyone interested in waterfowl in eastern Canada should read this book.

DAVID A. MUNRO

ARCTIC LIVING.
The story of Grimsey.
By ROBERT JACK. With a Foreword by Vilhjalmur Stefansson. *Toronto: The Ryerson Press, 1955. 8¼ x 5½ inches; 181 pages; illustrations. $4.00.*

Unlike the author of this book and unlike Dr. Stefansson, who wrote the Foreword, I have never set foot on Grimsey. And yet, I shall always remember it as well as a few other islands in far northern waters, if for nothing else, than for being where it is. For I have seen Grimsey as perhaps the Rev. Mr. Jack and Dr. Stefansson have not—from the cockpit of a storm-tossed aircraft, battered and exhausted and near the end of endurance, returning from icepatrols and escorting Murmansk-bound convoys, looking for land after many hours over black water and white ice. To see the cliffs of "the Grim Island" with foaming seas at the foot and fractured scud swirling over the tops, was like seeing a roadsign, a beacon. From there it was 30 miles SSW. to the mouth of Eyjafjördur, at the head of which was Akureyri, and "home".

We did not have much opportunity to know the Icelanders, but we saw them, at least, in such places as Reykjavik, Akureyri, Budareyri and Seydisfjördur. Flying over Grimsey we could occasionally see their houses and wondered what manner of people lived there. Now Robert Jack has told us. The story of this small island north of Iceland, with its sixty inhabitants, has been told as no native could tell it. The author lived there, spoke the language and served the people; he was one of them, and yet an "outsider". His book will be eagerly read by all who have visited Iceland, and it should be read by all who like to learn of life in far places. Grimsey is a lonely and difficult place to call home. Robert Jack should be congratulated for making a success of his years there, and for writing about them in such an entertaining way.

As a Scot, who learned to love Iceland and its people, the Rev. Mr. Jack must have much more to tell than this. He did what few "foreigners" could do, learned the language and obtained his degree at the University of Iceland, became an Icelandic minister and was accepted happily by his parishioners. Having lived in Iceland almost continuously since 1936, until leaving for Canada two years ago, the author must have observed and studied the people of the Saga Island in three different periods: prewar, wartime, and the years since 1945. Iceland, like most countries, has changed since 1939, and Robert Jack could be the man to interpret these changes. His

first book certainly proves that he can write with humour and understanding. Vilhjalmur Stefansson suggests in his Foreword that the next book by Robert Jack could perhaps be one contrasting Icelanders at home in their North Atlantic republic with the Icelandic pioneers on the prairies of Canada. Let us hope that the author will comply.

SVENN ORVIG

AYORAMA

By RAYMOND DE COCCOLA and PAUL KING with illustrations by James Houston. *Toronto: Oxford University Press, 1955, 9 x 6 inches; vii + 316 pages; illustrations. $4.00.*

The Copper Eskimo and the peoples to the east of them around Queen Maud Sea, had virtually no contact with European culture until early in the twentieth century, when the first independent traders appeared in the region. Since that time there have been few cultural changes until the last 15 years; during this period, the Copper Eskimo like all Canadian Eskimo have experienced great difficulties. To appreciate the cultural problems and the difficulties of administration, it is essential that the people in the south have objective accounts of the Eskimo and their way of life. However, few white people know the Eskimo well enough to give satisfactory accounts.

Father Coccola travelled as a missionary for 12 years with the Eskimo living around Coronation Gulf, Queen Maud Sea and particularly in Bathurst Inlet. In 'Ayorama', Eskimo for "it can't be helped", he has written, in collaboration with Paul King, a sensitive account of a people he knows intimately. The picture he draws is of Eskimo hardly affected by European civilization. Although they use a rifle and visit the trading store two or three times a year with their fox pelts, they essentially retain their old customs. The author says little about the impact of the trading companies, the missions and his own work, and the federal government, and only describes by inference the work of the Royal Canadian Mounted Police. The story that emerges is, however, one that has already been written many times for other Eskimo groups—the continuing threat of starvation, infanticide, polygamy, wife sharing, shamanism, and above all murder and manslaughter. The Copper Eskimo have always held life cheaply and the author mentions twenty-five cases of death where killings were suspected. Although at first this seems a large number for a population of less than 500, Rasmussen tells a similar story and Father Coccola does not, in fact, mention all the murders that have occurred in this century in Bathurst Inlet. From his account, one might believe that the killings are still occurring, but many of his stories are from the past and have been reported by the police. The author retells the story of the Radford and Street murders in 1912 but unfortunately his informant told him little that was not already generally known.

'Ayorama' is attractively presented with sketches by James Houston. It is doubtful if this book will have great value as an anthropological document because there are alterations in the factual accounts which limit their usefulness, but it makes a fine story and shows the Eskimo in a sympathetic light. When Father Coccola wrote the book it was already a story of the past, and the last year has brought even greater changes.

J. BRIAN BIRD

GEOGRAPHICAL DISCOVERY AND EXPLORATION IN THE QUEEN ELIZABETH ISLANDS

By ANDREW TAYLOR. *Ottawa: Queen's Printer, 1955. 9¾ x 6½ inches; vii + 172 pages; plates, maps.* (*Canada. Department of Mines and Technical Surveys. Geographical Branch. Memoir 3*). *$1.00.*

Mr. Taylor's purpose, as stated in the introduction to this memoir, is to "summarize the geographical discovery and exploration of the Queen Elizabeth Islands as an introduction and aid to other investigations in the area." This he has set about with great thoroughness and

has produced a valuable work of reference dealing with all expeditions to the Queen Elizabeth Islands from the problematical Norsemen to the voyage of the *St. Roch*. After an introduction describing briefly the extent and nature of the area, he proceeds to summarize the work of each expedition in turn, and for all the longer voyages a track chart is included. The major and minor works dealing with the expeditions are listed at the end of each description, and the references collected together in an altogether admirable bibliography which is undoubtedly the most valuable part of the book.

Another excellent feature is the listing of subjects dealt with in appendices to the main reports–geology, botany, etc.–and in many cases an assessment of the information on specific topics contained in the actual narrative. Thus it is of considerable value to the potential user to know that Parry's narrative of his first voyage is strong on accounts of optical phenomena but perhaps a little weak in geographical description, or that scientific information is hard to find in Peary's narratives but that he expresses himself at length on ice navigation. In fact this type of appraisal might well have been extended to more of the expeditions.

There is a real need for a work of this kind, and up to the present there has been nothing to fill it except P. D. Baird's "Expeditions to the Canadian Arctic" published in the *Beaver* in 1949. This has the advantage that it covers the whole Canadian Arctic, but its summaries, though good, are very short, and only the main reports of each expedition are listed. Moreover it stops at 1918, whereas Mr. Taylor brings his account up to the Second World War. A work of reference, however, cannot afford factual errors, and unfortunately this one is marred by a considerable number of small inaccuracies and omissions in the text and maps, which greatly reduce its value to workers in other fields who wish to save themselves the time of checking every fact to the original documents.

Since it is necessary to back up accusations of inaccuracy with evidence, here are some examples: In the account of Austin's expedition (1850-1) the sledge journey of Lieutenant Browne down the east coast of Prince of Wales Island is omitted from both text and map.

Krabbé of Kellett's expedition is said, in the text, to have made a sledge journey in 1854 to "make a depot at Cape Russell, the most westerly point of Melville Island, from which he crossed M'Clure Strait to inspect the *Investigator* at Mercy Bay." (p. 53). This should read Russell Point, the most easterly point of Banks Island. The map, correctly, shows no such visit to Cape Russell.

The northernmost point attained by Kane's party in 1854 is given in the text as Cape Constitution, but the map shows a track extending all the way to Hall Basin.

Sverdrup's second in command is given as Isachsen (wrong) on page 6 and as Baumann (right) on page 69. On the latter page he tells of Baumann's visit to Peary aboard the *Windward*, but on page 88 he attributes the same visit, wrongly, to Bay. (And is it not rather exaggerating Peary's hospitality on this occasion to say Baumann was "cordially received"?). A rather odd impression of the anatomy of Peary's feet is given in the same two references to this visit. On page 69 we are told that Peary "was fortunate in suffering no more than a frozen foot. . . .", and on page 88 that he had eight toes amputated!

The map on page 128 suggests that Corporal Anstead sledged right round Axel Heiberg Island in 1929, which is incorrect, although Corporal Stallworthy did so in 1932 in the search for Krüger.

Mr. Taylor has, on the whole, been admirably impartial in his text, but there are one or two sins of omission which are a little misleading. In dealing with the vexed question of the "eider duck shelters" in Jones Sound he goes in great detail into the theory that they are proof of Norse settlement in the area, but gives only a footnote to the objections to this theory. Nor does he mention that Baffin, having discovered the entrances

to Smith, Jones, and Lancaster sounds on his fine voyage in 1616, reported on his return that they were all enclosed bays and that there was no hope of a passage in this area.

These and other factual errors and omissions undoubtedly damage the book as an actual source of information, but do not affect its value as a bibliographical reference, in which respect it is first class. MOIRA DUNBAR

MAN IN A COLD ENVIRONMENT

By A. C. BURTON and O. C. EDHOLM. *London: Edward Arnold; Toronto: The Macmillan Company of Canada, 1955. 8½ x 5½ inches; xiv + 273 pages; maps, charts, and tables. $5.00.*

This book is greatly superior to most of those published in this field or any other field of physiology. The authors, besides being among the most active and best known workers in the subject of physiological and pathological effects of exposure to low temperatures have taken the time and the trouble to visit, personally, most of the laboratories working in the same sphere of interest in Canada, the United States and Great Britain; they were able to watch their immediate colleagues in action and discuss *in situ* the work in progress down to the finest details of technique and meaning, details that never appear in a satisfactory manner in the standard scientific papers. They were also able to have personal discussions with their colleagues "working in Scandinavia, Germany, Yugoslavia etc." The result is that the vast amount of information, compiled from other authors and presented in this book, is completely understood, assimilated, unified, and faithfully expressed. This book is, however, more than a well digested review: the latter is supported and preceded by a thorough exposé of all the fundamental problems involved, accompanied by a limpid discussion of the physical and physicochemical ideas necessary to understand how the cavalcade of experimental facts that are presented later are related to the problems to be solved–how all those little grains of sand fit into the skyscraper under construction.

What is the purpose of this book? It attempts to give a unified presentation of the problem of man in low temperatures. In addition, it discusses certain aspects of the problems which have scarcely been touched on before "particularly those of tolerance when heat balance is not possible, the state of hypothemia, general and local, the pathology of cold injury, and resuscitation from cold."

All through this book, one feels that there is a well conceived general plan. The reader is first presented with the historical and physical background necessary to understand the problems, through chapters entitled: "Homeothermy and history", "The problem of the homeotherm, the heat balance and physical laws", "The thermal insulation of the air", "The thermal insulation of the clothing or fur", and "The thermal insulation of the tissues of the body". These chapters are not a mere shadow of material more thoroughly discussed in text books on physics and physical chemistry; they are original in concept and structure, understandable without any concession to the truth, clear without eliminating the necessary details, and are easy and interesting to read. This is true for all the following chapters in which the biological implications are explained and discussed under the titles: "The possibilities of maintaining a thermal steady state in the cold, and how Arctic animals do so", "The estimation of the thermal demand of the environment", "Vascular reactions to cold", "The metabolic response to cold", "Acclimatization to cold" (by far the longest chapter due to the popularity and importance of the subject, and hence of the great amount of work reported), "Hypothermia and resuscitation", "Local cold injury", and "Problems for future research". References are given at the end of each chapter, and the thirteen chapters are followed by an Author Index and a Subject Index.

So much for the general plan and development of the whole idea. As far as

the structure and the presentation of each chapter is concerned, it is obvious that the authors both have a clear mind and an acute sense of pedagogy; each chapter has many subtitles corresponding to the many general ideas related to the subject of the chapter; under each of those general ideas are grouped very definite particular ideas, to each of which one single paragraph is devoted: a good example indeed of "the art of the paragraph".

Every physiologist, not only those working in the realm of bioclimatology, will enjoy reading this book and will profit by it; those working in this particular field will find that it is essential to consult it repeatedly and for a long time to come, due to the permanent actuality of many of its chapters, although the authors state that this book "is not really meant for those already working in the field".

The authors of such a book do not expect congratulations: they have attained their goal in writing a much-needed book which will be of great help to their colleagues, and they have done a splendid job. They must feel, for sure, that they have succeeded.

Without Dr. Morley Whillans of the Defence Research Board of Canada, this book might never have seen the light of the day: it is he who convinced Burton and Edholm to write it, who constantly encouraged them to continue it, and who made the arrangements for them to visit all the laboratories concerned in Canada and the United States. Dr. Whillans deserves our thanks and through him, the authorities of the Defence Research Board.

LOUIS-PAUL DUGAL

INSTITUTE NEWS

Award of Institute research grants

The following have been awarded research grants by the Institute for 1956:

BLACK, WILLIAM F. Dept. of Zoology, McGill University, Montreal, Quebec, Canada.

Problems of the identification, relationships, and distribution of arctic Mysidacea. Laboratory and library research.

Marine biological investigation along the coast of Boothia Peninsula, Northwest Territories, with special emphasis on the collection of littoral and benthonic animals, particularly crustacea and fishes.

DEANE, ROY E. Dept. of Geological Sciences, University of Toronto, Ontario, Canada.

Investigation of sedimentation in a pro-glacial lake, Barnes Ice Cap, Baffin Island, to determine if varved clays may be diurnal rather than annual deposits.

DEYRUP, INGRITH J. Barnard College, New York, New York, U.S.A.

A study of water and electrotype exchange *in vitro* in tissues of small mammals adapted to the arctic environment.

HUBLEY, RICHARD C. Dept. of Meteorology and Climatology, University of Washington, Seattle, Washington, U.S.A.

Glaciological research, Olympus Ice Field.

HURD, PAUL D., JR. Dept. of Entomology and Parasitology, University of California, Berkeley, California, U.S.A.

Analysis of soil invertebrates, Barrow, Alaska.

HUSTICH, ILMARI. Dept. of Botany, University of Helsingfors, Helsingfors, Finland.

Research on forest botany and tree

growth in the subarctic forests west of Hudson Bay, Manitoba.

IVES, JACK D. Dept. of Geography, McGill University, Montreal, Quebec, Canada.

Glaciological and geomorphological investigations in the Torngat Mountains of northern Labrador.

LACHAPELLE, EDWARD R. U.S. Forest Service, Alta, Utah, U.S.A.

Study of free water content of melting snow, Blue Glacier, Mt. Olympus, Washington.

LEPAGE, REV. ERNEST. Ecole d'Agriculture, Rimouski, Quebec, Canada.

A botanical exploration of Ungava from Fort George River via Sakami Lake to Eastmain River, Quebec.

MACPHERSON, ANDREW H. Dept. of Zoology, McGill University, Montreal, Quebec, Canada.

A study of the breeding biology, ecology, and taxonomy of gulls belonging to the *hyperboreus-leucopterus-argentatus* complex to be carried out in the region of Boothia Peninsula, Northwest Territories.

MACVICAR, DONALD G., JR. Dept. of Geology, Yale University, New Haven, Connecticut, U.S.A.

Detailed field study and mapping of the Pleistocene and bedrock geology of the Chandler Lake area, Brooks Range, Alaska.

MONTGOMERY, B. ELWOOD. Dept. of Entomology, Purdue University, Lafayette, Indiana, U.S.A.

Ecology of insects of the Arctic Slope of Alaska.

OLIVER, DONALD R. Dept. of Zoology, McGill University, Montreal, Quebec, Canada.

A general biological, physical, and chemical investigation of Lake Nettilling, Baffin Island, with special studies on the bottom fauna, fish, and seals.

PITELKA, FRANK A. Museum of Vertebrate Zoology, University of California, Berkeley, California, U.S.A.

Study of lemming ecology, northern Alaska.

POWER GEOFFREY. Dept. of Zoology, McGill University, Montreal, Quebec, Canada.

An investigation of the oxygen consumption, growth rates, feeding habits, and migratory habits of *Salmo salar*, *Salvelinus alpinus*, and *Salvelinus fontinalis* populations inhabiting the lower reaches of the George River in northeastern Quebec.

RITCHIE, JAMES C. Dept. of Botany, University of Manitoba, Winnipeg, Manitoba, Canada.

Vegetation and soil studies at Great Island, Seal River, northern Manitoba, with particular attention to the nature and delimitation of tundra types.

SHANKS, ROYAL E. Dept. of Botany, University of Tennessee, Knoxville, Tennessee, U.S.A.

Investigation of the composition, structure, and productivity of the tundra vegetation of northern Alaska.

TEDROW, JOHN C. F. Soils Dept., Rutgers University, New Brunswick, New Jersey, U.S.A.

A pedologic study of the soil-forming processes of the arctic coastal plain of Alaska.

THORNTHWAITE, C. WARREN. Drexel Institute of Technology. Laboratory of Climatology, New Jersey, U.S.A.

Climatic investigations in the Point Barrow region, Alaska.

WEEDON, ROBERT B. Dept. of Zoology, University of British Columbia, Vancouver, British Columbia, Canada.

A field and laboratory study of the ecology, life history, and behaviour of ptarmigan in the Yukon Territory with particular reference to adaptations to arctic life.

Research grants were awarded to the following for 1955, in addition to those published previously in *Arctic*, Vol. 8, pp. 130–2:

IRVING, LAURENCE. Arctic Health Research Center, Anchorage, Alaska.

Heat regulation of seals in cold air and water.

KANWISHER, JOHN W. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, U.S.A.

Investigation of freezing and living tissue.

SCHOLANDER, PER F. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, U.S.A.

Study of the relationship between atmospheric air and gas enclosures in glacier ice.

"Technical papers of the Arctic Institute of North America"

The Board of Governors has approved a new series of publications by the Institute, to be called *Technical papers of the Arctic Institute of North America.* The series, to be edited by Diana Rowley, will consist of papers too long or too technical for inclusion in *Arctic*; the papers will normally be published and sold individually. The first of the new series, "The plankton of the Chukchi and Beaufort Sea areas of the Arctic and its relation to the hydrography" by Martin W. Johnson, should be ready in early summer. The price will be announced at that time.

All manuscripts, whether intended for *Arctic* or the *Technical papers of the Arctic Institute of North America*, should be sent to Mrs. J. B. Bird, Secretary of the Publications Committee, at the Montreal Office.

The Institute library and map library

The Institute libraries are continuing to increase steadily. The following statistics for the year ending 31 December 1955 include items purchased and donated:

Accessions

Volumes	112
Pamphlets and reprints	424
Periodicals, subscription	21
Periodicals, exchange	104
Periodicals, complimentary	34
Maps	369
Books or periodicals bound or re-bound	63

During the past year the card catalogue has been increased by 5,112 cards, a comprehensive cataloguing and classification system having been adopted. Miss Nora Corley, the librarian, has also started the practice of sending cards for each item catalogued in the library to the National Union Catalogue, National Library of Canada, Ottawa.

Gifts to the library

The Institute library gratefully acknowledges gifts of books and reprints from the following persons and organizations:

T. E. Armstrong
S. Bleakney
A. Bursa
C. H. D. Clarke
Hannah Croasdale
M. J. Dunbar
J. T. Flakne
R. P. Goldthwait
H. B. Hachey
J. D. Ives
W. W. Judd
T. Lloyd
G. E. MacGinitie
T. H. Manning
D. Mascall
D. R. Moir
E. G. D. Murray
S. Orvig
A. E. Porsild
V. B. Scheffer
F. H. Schultz
J. D. Soper
W. C. Steere
J. C. F. Tedrow
W. Thalbitzer
H. R. Thompson
G. B. Van Schaack
D. Wilkinson
Arctic Health Research Center. Library.
California. University. Scripps Institution of Oceanography.
Canada. Department of Mines and Technical Surveys.
Canada. Department of Mines and Technical Surveys. Geographical Branch.
Canada. Department of National Defence. Defence Research Board.
Canada. Department of Northern Affairs and National Resources. Economic Division.
Canada. Department of Northern Affairs and National Resources. Education Division.
Canada. Joint Committee on Oceanography.

Canada. Fisheries Research Board. Pacific Oceanographic Group.
Canada. National Research Council. Division of Building Research.
Canada. Royal Society. Canadian Committee on Oceanography.
Canadian-Scandinavian Foundation.
Elisha Mitchell Scientific Society. Journal.
Engineering Institute of Canada. Library.
G. B. Foreign Office. Research Department. Antarctic Place-names Committee.
Hudson's Bay Record Society.
Iowa. State College. Iowa Engineering Experiment Station.
Life.
Mission Glaciologique Française au Hofsjökull (1954).
National Research Council, Washington, D.C. National Academy of Sciences.
Ontario. Department of Lands and Forests. Southern Research Station.
Swiss Foundation for Alpine Research.
U.S. Library of Congress.
Woods Hole Oceanographic Institution.

NORTHERN NEWS

Archaeological investigations in the Yukon Territory

During the summer of 1955 the National Museum of Canada archaeological expedition under the direction of Richard S. MacNeish excavated a site on the Firth River, Yukon Territory. The actual site is on the east bank of the river, close to the Richardson Mountains, about twenty miles from the Arctic Ocean, and thirty miles from Herschel Island. About 2,000 bone and stone tools were uncovered, along with about 6,000 pieces of pottery.

The site is a particularly large one, located at a caribou crossing and caribou lookout. Because of the strategic position it was occupied by numerous groups at different times. Preliminary excavations, to be continued next season, revealed nine different archaeological complexes. Three of these, all of which appeared in different places in the top humus, seem to be related to Eskimo remains from 400 to 2,000 years old. The other six archaeological complexes cannot be tied directly with the Eskimo and these peoples seem to have been adapted to caribou hunting rather than a maritime economy. The last three of these complexes have Asiatic-looking pottery, but lack ground slate, and have a large series of small end and side-blades as well as a few micro-blades and an occasional burin or burin-like tool.

The earliest of the pottery cultures has an artifact complex much like that found at Cape Denbigh, Alaska, with burins, micro-blades, and double-pointed end-blades, all very delicately chipped. Pottery was found in some of the pits that may be assigned to this cultural complex, but seemed to be absent from others. The pottery, while superficially resembling the grooved pottery is different in that its surfaces seem to have been struck with a cord-wrapped or thong-wrapped paddle.

Preceding these three pottery-making cultures are three earlier cultures. The latest appears to be related to that of Cape Denbigh, and is very like the latest pre-pottery manifestations that have been described from Siberia. Still earlier is a most interesting complex in which Early Man types of projectile points, known from the more southerly parts of the United States, are found in association with such Asiatic tools as crude burins and prismatic blades. All these cultural complexes are underlain by a still more primitive one represented by crude choppers and scrapers.

RICHARD S. MACNEISH

Arktisk Institut, a new Danish arctic institute

Although Greenland has belonged to Denmark for more than 200 years, and Danish scientists have been engaged in exploration and research in Greenland for over 150 years, Denmark was the last country with arctic possessions to found an arctic institute. The reason was that Denmark already had an institution to organize and coordinate scientific work in Greenland. This institution, Kommissionen for Ledelsen af de Geologiske og Geografiske Undersøgelser i Grønland (The Commission for the Direction of Geological and Geographical Investigations in Greenland), was appointed in 1878 and is still active, although under the more comprehensive name of Kommissionen for Videnskabelige Undersøgelser i Grønland (The Commission for the Direction of Scientific Investigations in Greenland). The importance and accomplishments of the Kommission cannot be overrated. Almost every year since it was founded expeditions have been organized and individual scientists have visited Greenland under its auspices, and there are few parts of this huge island that have not been studied at least once. Equally important is the series of publications entitled *Meddelelser om Grønland* which was started by the first Kommission and which, today, comprises 152 volumes. It is the oldest and most comprehensive series of arctic publications, containing information on all scientific subjects concerning Greenland.

Despite the indisputable significance of the Kommission, the need for an additional institution was felt to take care of the tasks which lay beyond its scope. For example, the Kommission has no permanent residence, and no place for the safe-keeping of journals, notebooks, maps, and photographs from the expeditions or individuals who have lived or travelled in Greenland or other arctic areas. Unfortunately much valuable material of this kind has already been lost, and it was this situation which primarily gave impetus to the founding of Arktisk Institut. That it was finally established is mainly due to the fact that a house owned by Skibsreder C. Kraemer og Hustrus Grønlandsfond was offered as a home for the new institute on very easy terms, and the interest of the Kraemer Greenland foundation was placed at the disposal of the institute. With this yearly income, other private contributions, and a state grant, the economic basis of the institute was secure, and on 4 June 1954 the statutes of Arktisk Institut were confirmed and ratified by His Majesty King Frederik IX.

According to Article 1 of the statutes "The objects of Arktisk Institut are to promote arctic research, particularly in Greenland, to disseminate knowledge of the arctic regions, and to keep contact between Denmark and foreign countries in all fields connected with this work". The ways in which the institute may further these objects are then listed. One of these is to collect, catalogue, and conserve diaries and papers from persons who have resided in or taken part in expeditions to Greenland or other parts of the Arctic. In addition the institute collects photographs and negatives; it already has a collection of several thousands from Greenland, some of them dating back to the 1890's. These photographs are available to the public who, on request and at their own expense, may have prints made and use them in publications. Arktisk Institut has a collection of lantern slides which is placed at the disposal of lecturers. A reference library, also open to the public, is being formed; it will be supplemented with a card catalogue of the literature on Greenland and other arctic regions available in the main libraries in Copenhagen and vicinity. Card catalogues of papers and photographs in other archives and institutions are contemplated. People intending to travel or do scientific work in the Arctic may obtain advice and assistance, and may borrow camping equipment, guns, cameras, and scientific instruments for field work.

Advice and assistance in practical and scientific matters are available to foreign research workers and institutions inter-

Photo: Official photograph, U.S. Navy

View inland, northeast Banks Island.

ested in studying Greenland, and Arktisk Institut offers its services in establishing contact between Danish individuals, scientific or public institutions and the corresponding individuals and institutions abroad. The institute will keep other countries informed of Danish research in Greenland and other arctic regions by a yearly report.

Arktisk Institut is directed by a board consisting of six members, of whom one is appointed by the Prime Minister, one by the Kommission for Videnskabelige Undersøgelser i Grønland, one by Skibsreder C. Kraemer og Hustrus Grønlandsfond, one by Grønlandske Selskab, and two are elected by the board. The day-to-day administration is carried out by a secretary, who may or may not be a member of the board. A council, the members of which are appointed by the Prime Minister upon the recommendation of the board, assists the board in all matters concerning the realization of the institute's objectives.

Although only a year old Arktisk Institut already proved its usefulness by the formation of archives containing much valuable material, and by assisting a number of people interested in Greenland from both Denmark and abroad. This is just the beginning. Much work in collecting and cataloguing is necessary before it is able to fulfil all the requirements laid down in its statutes.

HELGE LARSEN

Some notes on a trip to Banks Island

The writer was a member of the Joint Canadian-United States Beaufort Sea expedition in the summer of 1954. His primary responsibility was the installation and operation of electronics equipment to be used in surveying. The period from July 29 to August 28 was spent at a camp on the northeast coast of Banks Island, six miles south of Russell Point. During this time a number of field trips were made to explore the northeast portion of the island from Knight Harbour

on the northeast coast to thirty miles south of Russell Point on the south coast. We travelled mainly along the hard-packed beaches, because inland the area was almost totally inundated, due to the thawing of the active layer of the permafrost. This produced a sticky mud which restricted any form of travel inland.

While travelling along the beach shell specimens were collected. They were mostly Pelecypoda, and the most numerous species found was *Saxicava arctica*.[1] All the shells were dried and bleached. We saw no signs of marine life, and this lack of life was characteristic of the fauna of the area. Very few animals of any sort were sighted. The food and cover were such that the area could not support much wildlife. There were no lush plains similar to those in the southern portion of the island and the low hills were bare except for a sparse cover of yellow and brown moss, arctic willow, chickweed and arctic poppy.[2]

Inland the area was criss-crossed by numerous dry stream beds from which a number of specimens of loose rock fragments were collected. These included some fossils in limestone. Among the thirty-six fossils collected, Dr. W. H. Easton of the University of Southern California has identified coral specimens, including several Tetracoralla, and a few single specimens of several other anthozoans. He tentatively dates the Tetracoralla as Middle or Early Paleozoic, possibly Pennsylvanian or Mississippian.

[1]The following Mollusca specimens collected were identified by Dr. L. G. Hertlein, California Academy of Sciences, and Mr. W. K. Emerson, University of Southern California: Pelecypoda; *Saxicava arctica*, *Astarte* cf. *A. borealis*, *Serripes* cf. *S. groenlandicus*, and *Cyrtodaria kurriana*. Gastropoda and other classes; *Buccinum* cf. *B. solenum*.

[2]The following plants collected were identified by Dr. A. E. Porsild, Chief Botanist, National Museum of Canada: Arctic poppy (Flowering *Papaver radicatum*), Arctic willow (*Salix arctica*), Mountain sorrel (*Oxyria digyna*), Purple saxifrage (*Saxifraga oppositifolia*), Arctic mouse-ear chickweed (*Cerastium arcticum*), Chickweed (*Stellaria longipes*), and *Melandrium apetalum*.

Two small highly concentrated deposits of marine shells were found respectively three and four miles inland from the present-day beach. Both deposits are on hill tops several hundred feet above sea level, and both contained only *Saxicava arctica*. Apart from a few strand lines in the vicinity of Russell Point, no other evidence of raised beaches was found.

The writer was interested in the peculiarities of the streams and solifluction phenomena which occur throughout the area; future plans call for another visit to Banks Island to continue these studies. CHARLES RICHARDSON

Ornithological investigation of the mouth of the Anderson River and eastern Liverpool Bay, Northwest Territories

From 1 July to 25 August 1955 the writer made ornithological observations and collections in the Anderson River-eastern Liverpool Bay area.[1] It had been planned to begin work earlier in the season, but on arrival at Aklavik on June 4 I found that the Aklavik Flying Service was unable to take me to the mouth of the Anderson River until July 1. Stanton, the only settlement in the area was deserted of all its inhabitants that spring, and it was not possible to hire a native with a canoe and outboard motor as planned. This restricted my movements to what could be done on foot with a pack dog and a small ratting canoe, loaned to me by T. Lassard, a white trapper from the upper Anderson River, whom I encountered by chance two days after my arrival at the mouth of the river. Later Lassard and I launched a motor lifeboat belonging to the Roman Catholic Mission, Stanton, and on July 7 sailed it to Nicholson Peninsula, where we spent a few hours observing birds. From July 11 to 15 I walked from the mouth of the Anderson River to the mouth of the Mason River, returning to Stanton on the 16th. On July 18 a motor schooner in charge of J. R. Mackay, for the Geographical Branch, Ottawa, landed and I obtained

[1]This work was carried out under a Banting Fund grant to the Arctic Institute.

a passage to Harrowby Bay, the only point on the North American continent where the Slaty-backed Gull, an east Siberian species, is reported to have nested, in 1901. July 19 to 26 was spent on Harrowby Bay; from here I crossed Cape Bathurst peninsula to Amundsen Gulf, returning next day. In answer to a radio message from the schooner, a float plane of the Aklavik Flying Service arrived on July 26 and took me back to the mouth of the Anderson. The return journey included a low level flight over the creek draining into Harrowby Bay, and the Horton River from its mouth upstream for 20 miles. No Slaty-backed Gulls were seen and I believe that no breeding colony of these gulls exists in the area today, although one or two pairs might have been missed. There is reason to suspect that Ross's Geese might nest somewhere in this general area, but not on the lower Horton River, Harrowby Bay creek, or the mouth of the Anderson River and Wood Bay; however, I did not follow the Anderson upstream from its mouth. I had been told of a yellow-dyed goose seen at Toker Point in May 1955. This must have been one of a number of Ross's Geese so marked in California during the winter 1954–55. I hoped to determine whether the white-fronted geese nesting about the mouth of the Anderson were of the large subspecies *Anser albifrons gambelli*, the Tule Goose, the breeding grounds of which had not been found at the time of my operations. (Examples of Tule Geese were collected in the Mackenzie delta in the summer of 1955; A. C. Twomey, personal communication). White-fronted Geese with young were encountered on two widely separated lakes inland from Stanton on August 17, but I was only able to secure one of the immature geese and the skeleton with some adherent skin but only half grown wing feathers of an adult which must have been killed by some predator. The measurements of this bird strongly suggest that it was a Tule Goose, also when white-fronts were seen together with Black Brant the former appeared to be almost twice as large as the Brants making it highly probable that the Anderson River geese of this species are of the subspecies *gambelli*.

Estimates of local waterfowl breeding populations which I believe to be reasonably accurate were made as follows: Whistling Swan 3–400, White-fronted Goose 600, Lesser Snow Goose 500, Black Brant 1,000, Old Squaw 1,000. All species of birds observed in this general area by MacFarlane in 1861–66[1] were encountered in 1955 with the exception of the Eskimo Curlew, Ruddy Turnstone, Red Phalarope, Pomarine Jaeger, California Gull and Smith's Longspur. Species seen by myself not previously recorded for the area were Say's Phoebe and Rock Wren (observed at very close range) a remarkable record as this bird was fully 1,000 miles north of the normal northern limit of the range of this species. The Yellow Warbler and Rusty Blackbird, not recorded beyond the tree-line by MacFarlane, were found almost to latitude 70°N. in willow areas and the American Pipit, only presumed but not definitely recorded by him, was found in considerable numbers. As I worked alone, cooking and (net) fishing curtailed the time available for preparing specimens, but 45 bird skins, including a Hudsonian Godwit, an abnormally plum-aged Glaucous Gull, and 13 mammal skins and skulls were collected in the area, in addition to 21 bird skins and 4 mammals collected at points on my journey to the Anderson.

Sketch maps of the areas covered on foot (about 85 miles, much of it traversed more than once) were prepared. These show the correct position of Stanton, differing by about 8 miles from that shown on the 8 miles to the inch map of the area, Canada National Topographic Series, 1945 edition, and also contain two other corrections for the mouth of the Anderson River area.

Mammals seen or collected in the area

[1]MacFarlane, R. 1891. "Notes on and list of birds and eggs collected in arctic America, 1861–1866". *U.S. Nat. Mus. Proceedings, 1891*, Vol. 14, pp. 413–46. (Reprinted with corrections from the *Hist. and Sci. Soc. of Manitoba, Transactions, 1888–89*, No. 39).

were moose and muskrat, as far north as latitude 69°50′, arctic ground squirrel, meadow mouse, collared lemming, tundra mouse, barren ground caribou, ringed seal, and white whale. Bear tracks were found which were judged from the localities in question to be those of barren ground grizzly and polar bear respectively.

1955 was a high lemming year on the Cape Bathurst peninsula. Runs were abundant and considerable piles of lemming or mouse droppings were seen; Snowy Owls were correspondingly abundant in this area, 5 adults being in view simultaneously from one point on July 24.

I continued working in the area of my base camp at the mouth of the Anderson River until August 25, when I obtained passage in an aircraft flying south to Norman Wells. A detailed ornithological account of the expedition will be published elsewhere. E. O. HÖHN

Symposium on polar atmosphere

The Advisory Group for Aeronautical Research and Development, NATO, is currently planning a symposium on arctic meteorological problems. The meeting will be held in Oslo, Norway, during the first week of July 1956. It is hoped that representatives from all the NATO countries will attend. The program is not yet complete, but will include papers and discussions on arctic geography and climate, weather analysis and prognostic techniques applicable to the Arctic, radiation and thermodynamic problems, problems of observation and ice forecasting, and other subjects in the field of arctic meteorology.

Errata, Vol. 8, No. 2

Page 92, Fig. 5. The lateral moraine of the Taku Glacier, dated 1910, actually dates back to the eighteenth century.

ELECTION OF FELLOWS

At the Annual Meeting of the Arctic Institute held in Montreal on 19 November 1955 the following were elected Fellows of the Institute:

Dr. Robert G. Blackadar, Geological Survey of Canada, Ottawa, Ont., Canada.

Dr. Max E. Britton, Northwestern University, Evanston, Ill., U.S.A.

Robert M. Chapman, P.O. Box 4004, College, Alaska.

Dr. I. McTaggart Cowan, Department of Zoology, University of British Columbia, Vancouver, B.C., Canada.

Dr. Jack C. Haldeman, U.S. Public Health Service, Washington 25, D.C., U.S.A.

Dr. F. K. Hare, Department of Geography, McGill University, Montreal, Que., Canada.

G. Hattersley-Smith, Defence Research Board, Ottawa, Ont., Canada.

B. F. Heinzleman, Juneau, Alaska.

Dr. D. M. Hopkins, U.S. Geological Survey, Washington 25, D.C., U.S.A.

Dr. Desmond F. Kidd, 5816 Kingston Road, Vancouver, B.C., Canada.

Dr. Svenn Orvig, Arctic Institute of North America, 3485 University Street, Montreal, Que., Canada.

Capt. O. C. S. Robertson, R.C.N., H.M.C.S. *Labrador*, H.M.C. Dockyard, Halifax, N.S., Canada.

Dr. E. F. Roots, Geological Survey of Canada, Ottawa, Ont., Canada.

Donald C. Rose, National Research Council, Ottawa, Ont., Canada.

Dr. Robert S. Sigafoos, U.S. Geological Survey, Washington 25, D.C., U.S.A.

W. E. C. Todd, Carnegie Museum, Pittsburgh 13, Pa., U.S.A.

Marie Tremaine, Arctic Institute of North America, Study Room 261, Library of Congress, Washington 25, D.C., U.S.A.

Dr. G. M. Wright, Geological Survey of Canada, Ottawa, Ont., Canada.